JOURNAL OF DAIRY SCIENCE

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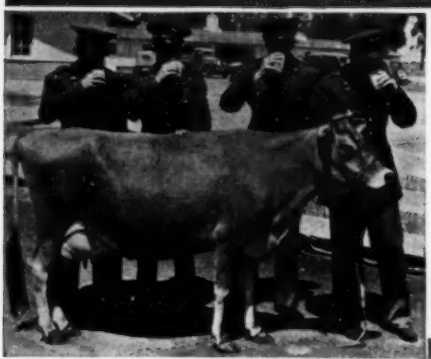

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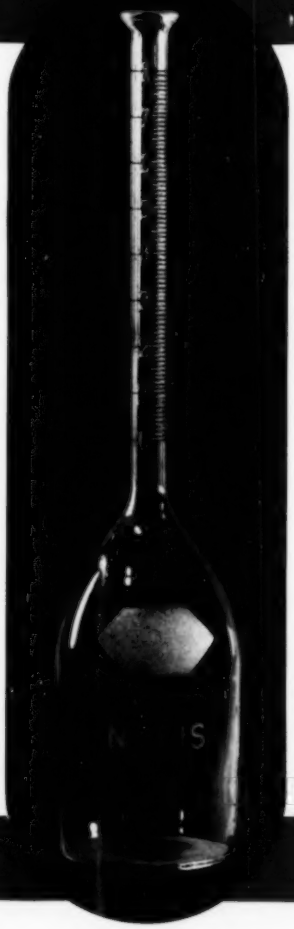

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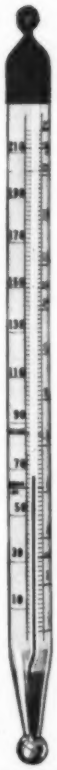

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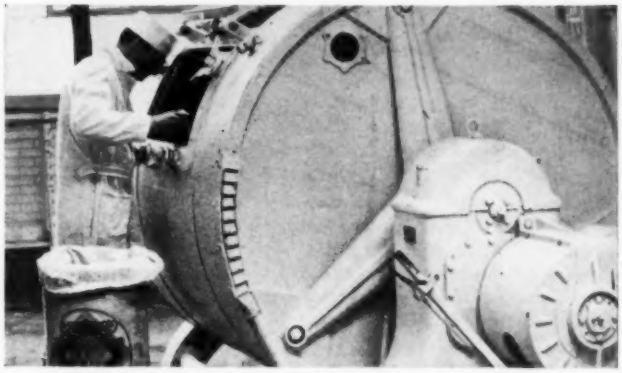

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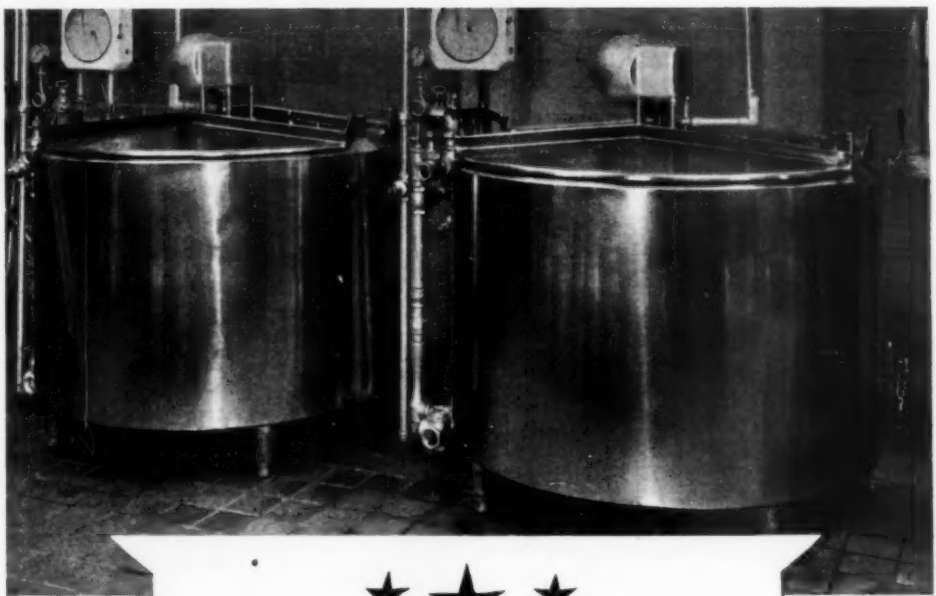

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JOURNAL OF DAIRY SCIENCE

VOLUME XXV AUGUST, 1942 NUMBER 8

PHOSPHOLIPIDS IN DAIRY PRODUCTS. I. DETERMINATION CHOLINE IN MIK FAT[1]

J. C. CRANE[2] AND B. E. HORRALL

Department of Dairy Husbandry, Purdue University Agricultural Experiment Station, Lafayette, Indiana

INTRODUCTION

Although they are present only as a minor constituent of milk, the phospholipids have received considerable attention in dairy chemistry, since they are regarded as having a part in the development of certain off-flavors in dairy products. The substance trimethylamine has long been considered to be formed by the oxidative deterioration of lecithin in butter and thus to give rise to a fishy flavor (9). Of further interest is the view that the phospholipids may undergo oxidation in sweet cream butter and thus cause the development of stale storage, bitter or metallic flavors (1), as well as other oxidative defects in other dairy products (4, 20, 24). They are also of interest due to their emulsifying, water-binding and other colloidal properties (6, 11, 17, 18).

Data on the quantitative determination of the total phospholipids have been based, for the most part, on the microchemical determination of phosphorus in extracted milk lipids. In recent years, methods have been developed for the microchemical determination of choline, which makes up one part of the lecithin molecule. It has been the object of the present work to apply one of these methods to the estimation of choline in fat extracted from dairy products.

REVIEW OF THE LITERATURE

The older work on the phospholipids and their structure is reviewed in the monograph of McClean and McClean (13); a more recent work is that of Thierfelder and Klenk (21). The review of Working and Andrews (26) has also recently appeared. For the present work, the facts that lecithin gives choline, fatty acids, glycerol and phosphoric acid on being split, and that cephalin gives the same residues, except that ethanolamine is said to

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[2] Submitted by John C. Crane in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Purdue University.

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appear in place of choline, and that spingomyelin is said to give sphingosine, choline, a fatty acid and phosphoric acid, are of interest.

In the extensive literature on the subject of phospholipids in milk and its derivatives, it was found that Müller (15) had reported choline and methyl guanidine in milk, and that Tolkachewskaya (25) isolated 0.36 gram of choline chloroplatinate from 20 liters of milk. Bischoff (3) obtained choline chloroplatinate from phospholipid material, which was prepared from extracted milk lipids. Osborne and Wakeman (16) obtained the compound in a similar manner. Diemayer, Bleyer and Ott (7) used the Roman (19) method to determine choline in milk phospholipids, which they prepared from lipids extracted from whole milk powder.

The micromethods for the determination of choline which were of interest in this investigation, were the periodide method of Roman (19), and later modifications of this by Erickson and co-workers (8), Beattie's colorimetric method (2), and the method of Thornton and Broome (23) which may be of more value in further work. Reineck's salt was used in this investigation for qualitative purposes, except for a few trials with the method of Beattie (2), and a trial of the method of Kapfhammer and Bischoff (12) with solution of choline chloride.

In preliminary work it was found that periodide precipitates could be obtained from extracted milk fat hydrolyzates. The milk fat was extracted by the Mojonnier method. It was then boiled with 5 N sulfuric acid. The aqueous and fat phases were separated, and washings were concentrated on the water bath to 25 or 50 ml. With such hydrolyzates, precipitates were obtained with Roman's solution and Reineck's salt. Reproducible results were obtained with duplicate samples of milk fat by the Roman method. On the basis of these facts, the use of this method for the determination of choline in extracted milk fat was investigated.

EXPERIMENTAL PROCEDURES

The procedure for the determination of choline, as used in this investigation, was as follows: a 3 to 5 ml. aliquot of the neutral or slightly acid hydrolyzate or solution, containing not more than 1 milligram of choline, was placed in a 15 ml. glass-stoppered centrifuge tube. It was treated with 0.3 ml. of the Roman reagent (157 grams of iodine and 200 grams of potassium iodide in 1 liter of water per ml. of hydrolyzate). The sample was centrifuged for 3 minutes at a speed of at least 2500 r.p.m., and preferably 3,000 or more r.p.m. (lower speeds were not satisfactory). The tubes were then placed in ice water for at least 30 minutes. The thorough cooling of the tubes before filtering and washing the choline periodide was very important, and conditions had to be maintained at near the freezing point for good results. After the cooling, the excess precipitating reagent was poured off through filter paper on a chilled 16-mm. Buchner or Hirsch funnel. The

precipitate was washed rapidly with five or six 2-ml. portions of ice-cold water until free from iodine solution.

The filter paper was returned to the centrifuge tube and the precipitate taken up in 3 ml. of chloroform. The chloroform solution of iodine was titrated with 0.01 normal sodium thiosulfate solution until the pink iodine color disappeared. A drop of starch indicator was also used.

Since the factor as used by Roman to calculate the weight of choline from the titration values obtained with thiosulfate was found by others (22) to yield only about 90 per cent of the choline actually present by weight, it was desired to derive a factor in order to arrive at a basis for calculating results. In each of two different trials, stock solutions of pure choline chloride were used. The choline chloride was recrystallized three times from absolute alcohol and dried in an Abderhalden drier at 84° C. The weighed bulb containing the salt was sealed immediately on being removed from the drier, then weighed to obtain the amount of choline, and finally broken in a beaker of water. The water was made up to volume, so that the weight of choline chloride per ml. was known. This was the stock solution and contained approximately one milligram of choline chloride per ml. To test the Roman method, this stock solution was diluted ten times before use. Several determinations were made by the method and enough choline was present in all trials to give a titration value of from 3.2 to 4.5 ml. of 0.01 N sodium thiosulfate.

The figures in table 1 represent milligrams of choline per milliliter of stock solution, as determined by the various methods.

TABLE 1

Comparison of the Roman method with various other methods for the determination of choline in dilute choline chloride solutions

Trial	Weight of choline per ml.	Calculated* from total nitrogen determination	Calculated† from weighed chloroplatinate	Calculated from Roman method	Per cent recovery by Roman method
1	0.125	0.130	0.128	0.122	95.3
2	0.107	0.103	0.106	0.098	93.3

* Total nitrogen was determined on the concentrated stock solution by the Kjeldahl method.

† The chloroplatinate was obtained from the concentrated stock solution and determined according to Thierfelder and Klenk.

The results obtained on the standard choline solutions by the direct weight, total nitrogen and chloroplatinate methods showed good agreement. The periodide method gave an average of 94.3 per cent recovery of the amount of choline present, when the factor as recommended by Roman was used.

Thus the factor, 0.1335 + 0.943 or 0.1415 milligrams of choline was taken as equivalent to one milliliter of N/100 sodium thiosulfate solution, in this investigation.

For example, if a 3.69 gram sample of extracted milk fat required 1.92 ml. of 0.009 N thiosulfate to titrate the choline periodide from a 1/10 aliquot of the hydrolyzate, then, assuming the lecithin to be stearyl-oleyl lecithin, and to have a molecular weight of 806, and with choline having a molecular weight of 121,

$$\frac{1.92}{1000} \times 0.1415 \times \frac{0.009}{0.010} \times 10 = 0.00245 \text{ grams of choline in the sample.}$$

Then,

$$0.00245 \times \frac{806}{121} \times \frac{100}{3.69} = 0.442 \text{ per cent of lecithin in the sample.}$$

As carried out at first, the usual procedure for lecithin hydrolysis (14) was followed with extracted milk fat. This involved boiling the fat with 5 N sulfuric acid for 15 hours and subsequent removal of the acid as barium sulfate. It was desired to simplify these conditions as much as possible, in order to shorten the time for a determination.

An egg phospholipid preparation was made up according to the procedure of Bull and Frampton (5). This material had the following analysis: 3.61 per cent phosphorus, 1.73 per cent nitrogen, 10.5 per cent choline (Roman method); iodine number 68.5. This was dissolved in chloroform to give a solution containing 4.2 grams of the preparation per 100 ml. This was stored in the refrigerator in the dark. Sweet cream was then churned and the butter melted to obtain a butter oil. To 958 grams of the oil were added 100 ml. of the chloroform-phospholipid solution. The $CHCl_3$ was removed in a Claissen flask at 60 to 70° C. in a stream of nitrogen. The Mojonnier test showed 99.5 per cent of fat to be present. The mixture was then analyzed for phosphorus (10) and choline. The results are shown in table 2.

TABLE 2

Analysis of butter oil-phospholipid mixture for choline

Fat	Sample grams	Aliquot of hydrolyzate	Ml. of 0.0090 N thiosulfate	Mgm. choline present	Per cent choline in fat	Per cent lecithin in fat
Mixture	10.0	3/25	4.71	5.00	0.050	0.33
Mixture	10.0	3/25	5.00	5.30	0.053	0.35
Butter oil	20.0	3/25	0.15	0.18	0.0009	0.006
Butter oil	20.0	3/25	0.16	0.18	0.0010	0.006

The amount of choline in the fat as calculated, was 0.046 per cent. The results for phosphorus showed that 0.0158 per cent phosphorus was added to the butter oil and that in two trials 0.0159 and 0.0150 per cent were recov-

ered. This corresponded to 0.41, 0.41 and 0.39 per cent phospholipids respectively, in the oil. Blank determinations on the oil showed 0.005 per cent phospholipids.

The experiment was repeated with 497 grams of butter oil and 50 ml. of the chloroform-phospholipid mixture. The amount of phosphorus found averaged 0.0153 per cent; by calculation, 0.0153 per cent. This mixture was then subjected to hydrolysis with hydrochloric acid for various lengths of time. The amount of fat mixture used was 10.0 grams and 25 ml. of each strength acid were used. After the hydrolysis, the hydrolyzate was filtered off, the fat washed, the excess acid neutralized, and the hydrolyzate and washings evaporated to less than 50 ml. in the water bath. The hydrolyzate was then cooled, made to volume and tested for choline, as shown in table 3.

TABLE 3

Effect of variation in hydrolysis conditions on the analysis for choline

Strength of HCl used	Time of hydrolysis in hours	Aliquot of hydrolyzate used	Ml. of 0.0134 N thiosulfate	Mgm. choline found
5 N	3	6/50	2.46	3.8
5 N	10	6/50	2.60	4.1
5 N	18	6/50	2.55	4.1
1 N	3	6/50	2.68	4.3
1 N	10	6/50	2.75	4.4
1 N	18	6/50	2.60	4.1
N/2	3	6/50	2.70	4.1
N/2	10	6/50	2.77	4.4
N/2	18	6/50	2.64	4.2

The blank was 0.17 mgm. and the amount of choline added was 4.45 milligrams for 10 grams of fat. When weighed out, the fat contained 1.7 per cent of solvent. Thus, recoveries of 84 to 95 per cent were obtained, the average being 91 per cent. A recovery experiment was also made using lecithin prepared by the cadmium chloride precipitation method, with similar results.

The recovery of choline added as choline chloride to butter oil, with subsequent carrying through of the hydrolysis procedure was then undertaken.

A number of other trials were made using different stock solutions. The general average was 96 per cent recovery of choline. It was noted however, that it is necessary to have thorough cooling of the periodide precipitate or the losses become greater than 5 per cent. It was also noted that the amount of choline present should not give a titration value greater than 8 ml. of 0.01 N thiosulfate (22), otherwise too high results may be found.

In another set of trials, recovery of choline from mixed, slightly acid hydrolyzates from extracted milk fat was carried out to see whether or not there was any substance present which would interfere with the results.

In the first trial, 3 ml. of the hydrolyzate plus 3 ml. of standard choline required 3.88 ml. of thiosulfate. Three ml. of the hydrolyzate had originally required 1.99 ml. thiosulfate and 3 ml. of the standard choline solution required 1.99 ml. of thiosulfate. This showed a recovery of 97 per cent. In the second trial, 5 ml. hydrolyzate required 2.51 ml. thiosulfate; 5 ml. standard choline required 2.94 ml. of thiosulfate, and 5 ml. hydrolyzate plus 5 ml. choline required 5.55 ml. thiosulfate. This recovery was then 102 per cent. It was concluded that there was no interference with choline periodide precipitation in these instances. It is to be noted, however, that a clear solution must be had for the best results.

The extent to which duplicates agree in the proposed method of analysis for lecithin in extracted milk fat is shown by the following data for samples of milk, the fat for hydrolysis being obtained by the Mojonnier extraction method. The blank was taken as 0.05 mg. choline. The blanks found with butter oil hydrolyzates were from 0.05 to 0.20 ml. of 0.01 N thiosulfate.

TABLE 4

Determinations of choline and lecithin in fat from samples of whole milk

Sample cow	Fat test per cent	Grams fat hydrolyzed	Ml. 0.0102 N thiosulphate for 1/5 aliquot	Mgm. chloline in sample	Per cent lecithin in fat
58 A	3.74	4.24	1.90	1.36	0.21
58 A	3.74	4.24	1.75	1.27	0.19
58 A	3.74	4.20	1.88	1.36	0.21
58 A	3.74	4.20	1.93	1.40	0.21
450	5.07	4.12	1.94	1.52	0.24
450	5.07	4.12	1.96	1.42	0.22
450	5.07	4.16	2.10	1.52	0.24
450	5.07	4.16	2.15	1.56	0.24

Usually a 3 to 5 gram sample of extracted fat gave satisfactory results when boiled with 20 to 30 ml. of normal or half-normal HCl, with subsequent concentration of the hydrolyzate and washings to 25 ml.

DISCUSSION OF RESULTS

A number of experiments were made to determine the consistency of results obtained when extracted butterfat was subjected to relatively mild acid hydrolysis and the choline determined in the neutral or slightly acid hydrolyzate by a method which was modified slightly from that of Roman. The values obtained were consistent under the proper conditions, although the choline periodide is unstable at temperatures much above the freezing point. It was further found that in agreement with other work (22, 23), the factor which was recommended by Roman does not account for all the choline present in aqueous solutions. A corrected factor was used.

Tests made with hydrolysis procedure showed that aqueous normal hydrochloric acid was suitable as a hydrolysing agent for the splitting of

the choline from the lecithin in the extracted fat. A three to five gram sample, or more, of fat was used.

Choline, which was added as freshly prepared egg phospholipids to butter oil which was low in phospholipids, was recovered to the extent of 91 per cent by the procedure. The recovery of choline added as the chloride to butter oil, and to hydrolyzates from extracted milk fat averaged 96 per cent.

SUMMARY

A modified Roman micromethod has been found applicable to the analysis of extracted milk fat for choline. A method for the determination of choline-bearing phospholipids in dairy products was thus found.

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A NEW COLORIMETRIC METHOD FOR THE DETERMINATION OF FREE FATTY ACIDS IN MILK FAT

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It has been recently shown (3) that the free bases of a number of common basic dyes may have different colors from their salts, and that they are soluble in neutral fat, xylol and alcohol, but slightly soluble or insoluble in water. It was also shown that the hydrolysis of neutral fat can be demonstrated by dissolving a suitable dye base in the neutral fat and observing for the shift in the color of the solution toward that of the salt. It has also been shown (4) that the degree of development of color of the soap is directly related to the concentration of the free fatty acids, and that fact formed the basis of a quick test of the quality of butter. In the present paper, we are concerned with the application of the above principle in a general procedure for the determination of free fatty acids in milk fat, a procedure which, obviously, can also be used for the same purpose in the study of fat in other dairy products.

PROCEDURE

The sample of milk fat was prepared from milk by the method of Herrington and Krukovsky (1) and the concentration of fatty acids was determined both by titration with 0.05 N NaOH (Herrington and Krukovsky (1)) and by the present procedure which is similar to that used by Knaysi and Guthrie (4) modified to fit the requirement of exact analytical work.

One ml. of the sample of milk fat was measured into a test tube which had been painstakingly cleaned with dichromate cleaning mixture, liberally rinsed with running and distilled water and allowed to dry in the oven. To this ml. of milk fat 3 ml. of a saturated solution of neutral red base in chemically pure xylol were added and the tube was gently shaken to promote dissolving of the fat. The color of the solution is then compared to that of standards containing known quantities of oleic acid in test tubes of approximately the same diameter. That can be done immediately or at one's leisure, for when the tube containing the milk fat is tightly stoppered with a cork lined with a piece of tin foil, no change in its color is detected even after standing for 2 days. Corks that have been exposed to acid or alkaline fumes and vapors should never be used in this work.

The standards are prepared as follows: 0.5647 gm. of pure oleic acid is weighed in a 50 ml. volumetric flask, and the flask is filled to the mark with chemically pure xylol; 1 ml. of this solution is also diluted with xylol to 10 ml. That gives, respectively, a 0.04 and a 0.004 normal oleic acid in

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xylol. Now ten test tubes cleaned and dried as mentioned above, and of the same internal diameter, are labelled 0, 1, 2, 3, 5, 7, 10, 12, 15, 20. To each test tube is added oleic acid solution, pure xylol and saturated neutral red base solution in xylol in the quantities indicated in table 1. It is obvious

TABLE 1

Preparation of the standards

No. of standard	Ml. of oleic acid		Ml. of xylol	Ml. of satur. dye base sol.	Normality of oleic acid
	0.04 N	0.004 N			
0	0.00	0.00	1.00	3.0	0.0000
1	0.10	0.00	0.90	3.0	0.0001
2	0.20	0.00	0.80	3.0	0.0002
3	0.30	0.00	0.70	3.0	0.0003
5	0.50	0.00	0.50	3.0	0.0005
7	0.70	0.00	0.30	3.0	0.0007
10	1.00	0.00	0.00	3.0	0.0010
12	0.00	0.12	0.88	3.0	0.0012
15	0.00	0.15	0.85	3.0	0.0015
20	0.00	0.20	0.80	3.0	0.0020

that when the standards are thus prepared and labelled, the number of the standard gives the normality of oleic acid multiplied by 10^{-4}. The standard containing no oleic acid is orange yellow with a green fluorescence, while the other standards have a reddish tinge in proportion to their oleic acid content. They are stable and can be kept for weeks when tightly stoppered with corks free from acid or alkali vapors and lined with tin foil. When not in use, the standards should be kept in a cool, dark place. The above series is considered adequate for it is possible to estimate shades intermediate between those of two consecutive standards.

DATA AND DISCUSSION

A comparison between the results of titrations by the procedure of Herrington and Krukovsky (1), expressed as normality of fatty acids, and those determined by the present method are given in table 2 and show close agreement. The 18 samples of milk fat originated from six different lots of milk. Each lot was divided into 3 portions, the first portion was pasteurized immediately and the two others cooled at different rates. The data, therefore, confirm the finding of Herrington and Krukovsky (2) that a slow rate of cooling of the raw milk promotes lipolysis.

In view of the very low concentration of free fatty acids in normal milk, and the fact that only 1 ml. of the milk fat is required, it may be concluded that the method we are presenting is of very high sensitivity. Differences in the carotenoid content of various milk, in the dilution used and in the presence of the base of neutral red, seem to have no noticeable effect on the accuracy of the method, and the color, which is due to intramolecular rearrangement of the base upon salt formation, is independent of the nature of

TABLE 2

The free fatty acid content of milk fat

Sample No.	Normality of free fatty acids		Remarks
	Dye base method	Titration with NaOH	
1	0.0005	0.0005	Immediately pasteur. Control
8	0.0026	.....	Cooled in can*
9	0.0008	0.0009	Cooled over surface cooler
2	0.0007	0.0008	Immediately pasteur. Control
10	0.0010	0.0012	Cooled in can
11	0.0007	0.0008	Cooled over surface cooler
3	0.0006	0.0006	Immediately pasteur. Control
12	0.0019	0.0019	Cooled in can
13	0.0008	0.0010	Cooled over surface cooler
4	0.0005	0.0005	Immediately pasteur. Control
14	0.0011	0.0013	Cooled in can
15	0.0006	0.0007	Cooled over surface cooler
5	0.0005	0.0005	Immediately pasteur. Control
16	.....	0.0019	Cooled in can
17	0.0008	0.0009	Colled over surface cooler
6	0.0006	0.0006	Immediately pasteur. Control
18	0.0011	0.0013	Cooled in can
19	0.0007	0.0008	Cooled over surface cooler

* 40 qt. can.

the fatty acid and is the same for the same normal concentration of the various soaps formed.

SUMMARY

A simple and quick colorimetric method for the determination of free fatty acids in milk fat is described. The method consists in dissolving 1 ml. of the milk fat in 3 ml. of a saturated solution of the base of neutral red in xylol and comparing with a set of standards of known oleic acid contents. The method is shown to be highly sensitive and accurate. In neutral fat and in xylol the dye base gives an orange yellow solution. Free fatty acids form red soaps with the dye base and the degree of shift to the red is proportional to the concentration of soap and, therefore, of the free fatty acids. Equal normal concentrations of various fatty acids produce an equal shift in the color.

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A METHOD FOR SURFACE AREA MEASUREMENT OF MILK BOTTLES*

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The problem of the horticulturist in calculating the leaf surface of a fruit tree for measurement of the spray covering is similar to that of the milk plant manager or experimentalist who wishes to determine the amount of water and washing powder required to wash milk bottles of varying sizes. Many factors complicate his problem, chief of which is the fact that usually three sizes of bottles are washed, the total number varying each day, as well as the distribution of sizes. This serves to make any calculation of washing powder only approximate. Other factors, also confusing, are shape of the bottle and thickness of its walls.

Displacement calculations may be utilized as a simple method for determination of the volume of glass in a bottle but they are valueless as a measure of the surface area, due to irregularity in shape. Since both the inside and outside areas of the bottle must be washed it is necessary that both be measured. From these values may be obtained a ratio from which the areas of pint and half-pint bottles may be converted into quart-equivalent area. It would seem logical to calculate amounts of water and washing powder required in washing bottles in terms of the amounts required to wash a quart bottle. In the discussion which follows, the surface areas of three standard size milk bottles have been calculated and the method of calculation given.

The approximate area of the outer and inner surface of a milk bottle can be found by dividing the bottle into small sections as is shown in fig. 1. Each of the sections is a frustum of a cone whose surface area is:

$$\text{Area} = \frac{\pi}{2} s [(D_1 + D_2) + (d_1 + d_2)],$$

where s is the slant height, D_1 and D_2 are respectively the upper and lower diameters and d_1 and d_2 are respectively the upper and lower inside diameters. In figure 1 (a) is shown one of these sections in detail; this is section SRUT which is located on the neck of the bottle and is similar to the other sections. The various diameters D_1, D_2, d_1 and d_2 together with the slant heights are shown. The sum of the outer and inner surface areas of this small section is:

$$\text{Area} = \frac{\pi}{2} (RT) [(RS + TU) + (R'S' + T'U')]$$

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The sections were taken so that the slant height fell along a straight edge. The slant height of the above section is RT and it is a straight line. Where the curvature of the surface of the bottle was large, heights of the sections were small, some of them being as small as 1/32 inch. At places where the curvature was large there were several sections. Section KMBA was the largest, for on this part of the bottle the lines MB and KA were straight lines. There were eleven sections between KM and TU, four at the bottom of the bottle and six at the top. It was possible to divide the bottle into frustums of cones by making the sections small enough.

The diameters RS, KA, CD, etc., were measured with a caliper which read to hundredths of an inch. After the bottle was broken in several

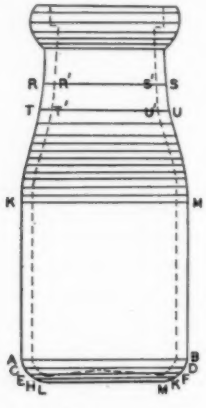

Fig. 1.
Half Pint

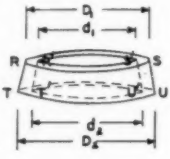

Fig. 1a.
Section RSUT

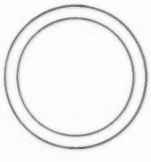

Fig. 1b.
Top Ring

places thicknesses of the glass were measured. The inside diameters were obtained by subtracting twice the thickness of the glass from the corresponding outside diameters. The thickness of the glass varied for different parts of the bottle. The neck consisted of thicker glass than the body of the bottle, the glass at the top being the thickest. The bottom of the bottle on the inside was shaped like a cone. Its area was found by using the formula for the surface area of a cone. The part of the bottom which rested on a flat surface was a circle. The very top of the bottle was a ring as is shown in figure 1(b). The area of this ring was found by subtracting the area of the inner circle from the area of the outer circle. The following table contains the surface areas of a quart, a pint, and a half-pint milk bottle.

The ratio of the surface area of the pint and the surface area of the quart is 0.62; the ratio of the area of the half-pint and the area of the pint is 0.66. The ratio of the area of the half-pint and the area of the quart is

Surface area of milk bottles (sq. in.)

Surface	Quart	Pint	Half-pint
Outside	106.58	65.64	43.52
Inside	93.82	58.24	38.81
Outer and inner surfaces	200.40	123.88	82.33

0.41. Small errors may have been made in measuring the various parts of the bottles. The above figures can be taken as very close approximate values of the surface areas of these three milk containers.

The surface area of a quart bottle of the design used in these calculations is 1.62 times greater than that of a pint bottle and 2.43 times greater than that of a half-pint bottle. To convert pints and half-pints to their quart equivalents merely multiply the numbers by their respective ratio. Thus, if 1000 quarts, 200 pints, and 800 half-pints were to be washed, the quart equivalent would amount to 1000, plus 200×0.62, plus 800×0.41, or an equivalent of 1452 quarts.

ABSTRACTS OF PAPERS PRESENTED AT THE THIRTY-SEVENTH ANNUAL MEETING

June 22–25, 1942

EXTENSION SECTION

Testing Committee Report

A. Maintaining Qualified Tester Personnel. A. J. CRAMER, Univ. Wis., Madison, Wis.

"Greater Production for Defense and Victory," depends on maintaining qualified Supervisor Personnel.

A. Locating and training Prospective Supervisors.

1. Streamlined Supervisor Courses.

A five-week supervisor or fieldman's training course is given each year in February and March to boys attending the Short Course at the Wis. College of Agriculture. In addition to other classes, a two-hour-a-day class was taught by the staff of the Dairy Records Office. Studies on Dairy Cattle Breeding, the application of records and the duties of fieldmen were emphasized. The course involves the testing of milk, balancing of grain rations, the filling out of monthly reports and other forms. Records for a barn book and a sample members herd record book are kept by the students on a herd of a member for one complete years work. Instructions are given on services a member should receive, methods of organizing and maintaining a Standard Dairy Herd Improvement Association.

Many of our Smith Hughes High School Agricultural teachers are offering courses to students as preliminary training for a supervisors job.

One- or two-day training courses, under the supervision of the Dairy Records Office, have been offered to prospective fieldmen at High Schools throughout the state.

Our standard D.H.I.A. fieldmen have trained applicants by allowing these men to do the Supervisors work on a number of farms which work is supervised by the regular fieldman. This method has proved most satisfactory when the better trained supervisors give the instructions.

We were only fairly successful in locating prospective supervisors by placing a "Help Wanted" ad in a State Farm Paper, which read: "Dairy Fieldman for Testing Associations—High School Agricultural Course or Short Course graduates preferred." County Agents have been fairly successful in locating boys on farms within the county, through advertising in local papers.

B. Deferment of Supervisors.

Our County Agents, D.H.I.A. Members and Members of the Dairy

Record Office have been fairly successful in retaining Supervisors by writing letters to the local draft boards, explaining the importance of deferring the Supervisors. In many instances the draft boards have deferred the men for a third time.

C. Maintaining Equipment of Supervisors.

1. Cars and Tires.

A letter was mailed to all County Agents and D.H.I.A. fieldmen, the contents of which was taken from a letter written by J. F. Kendrick, Chief, Division of Dairy Herd Improvement Investigations, Bureau of Dairy Industry. Here it is: "D.H.I.A. Supervisors may obtain recaps under the rating B–A–3. This rating includes passenger cars used principally for providing transportation to technicians, essential to the war effort in the field of Agriculture." The D.H.I.A. program is regarded as essential to the *More Milk* Program.

One of our fieldmen obtained a new car soon after the rationing board received the request. Some boards refused to grant recapped tires to fieldmen, because the board had not received the priority rating literature. Their cases are pending.

2. Glassware and Acid.

Sulphuric Acid and Glassware have been obtained so far, since the Office of Production Management submitted the following information Preference Rating Order No. P–62, which deals with materials for the production of laboratory equipment and reagent chemicals. This order should make available without special preference ratings, all the reagent sulphuric acid that might be needed for milk testing.

D. Results.

So far we have been able to maintain a large number of our Associations with Supervisors by advertising for help wanted and by giving courses helpful toward the training of new men. Some draft boards have been lenient with our supervisors by deferring them.

Our fieldmen have been fairly successful in getting equipment as glassware and acid and also in obtaining used and recapped tires.

B. Supervisory Problems. H. E. Loveland, Univ. Vt., Burlington, Vt.

The war situation is making it necessary to adjust D.H.I. association work so it will reach the largest number of producing cows with a shortage of testers, and testers with limited training, experience, and qualifications for the job. These conditions make it necessary for the membership to realize the need of adjustments and to be willing to cooperate in the use of methods which are new and often not popular. To secure these adjustments without loss of members, and with minimum loss of accuracy requires:

(1) that associations be locally organized with active management by directors, and

(2) that membership be kept informed through letters and occasional meetings.

Probably most associations in the country are so organized, but often the officers do not feel their responsibility. Monthly letters from the state office, annual reports, occasional letters for special information, annual meetings, conferences of groups of officers, are methods which may be used.

The high value of D.H.I. association testing for promoting the increased production goals set by the U. S. Department of Agriculture requires the coordination and cooperation of different associations in a territory to keep the records coming. It is better to have acceptable records from all herds than good records from a few herds, and none from the balance. Thus, the supervision should include furnishing information on how goals are being reached, methods of reaching same, the necessity of continuing records, and how associations can cooperate with each other.

The above statement does not mean that we should let down on the aim of high standards and we should educate the testers and help in selection of testers to do the best job possible. When these standards cannot be fully maintained, we should aim for as many records as possible on an acceptable basis for publicity and proving of sires.

The extension of a testing program to other dairymen should be on basis of publicity of sources of D.H.I. association tested herd sires, methods of herd management successfully used by D.H.I. association members, and adoption of other forms of keeping records which will give those unable to join a D.H.I. association some kind of private records for use in herd improvement.

C. Emergency Adjustment in D.H.I.A. Procedure. C. R. GEARHART, Pennsylvania State College, State College, Pa.

War conditions make it necessary to make adjustments in our D.H.I.A. procedure. Problems confronting Supervisors are numerous, including: How to keep the D.H.I.A. program up to standard with a shortage of testers, tires, gas, paper, and proper supervision.

This paper shall attempt to outline Emergency Adjustments made by the various states up to April 1, 1942, and to list suggestions for further adjustments.

Special attention will be given to:

1. *Cooperative Grouping of D.H.I.A.'s.*

Under this system a number of associations agree to exchange testers, temporarily, in order that no member shall lose more than one month's testing at a time. With 8 associations in the group it would mean in a case of a shortage of testers, all members may miss one or two month's testing during the year, but none will lose out entirely.

2. *Multiple Testing.*

a. Doubling herds.

The regular method of doubling herds as mentioned in the Tester's manual.

b. Doubling testers or Tester and Assistant.

This will include two testers using one car to save tires, or a regular tester taking an assistant with him, in some cases it may be his wife. The assistant will be dropped at one farm while the regular tester goes to the next farm, the two getting together to do the testing and record work. This gives the regular tester an opportunity to supervise the work of his assistant.

3. *Laboratory Testing* (*disinterested sampler*).

Under "Laboratory Testing" is the method of having samples taken by disinterested samplers and brought in to a regular tester, or to a central laboratory for testing. These samplers may be a group of regular testers, or they may be 4–H club members, Vo–Ag students, or local dairymen who take samples on other than their own herds.

4. *Bi-Monthly testing* is the regular method as outlined in the Tester's Manual.

Due to unforseen circumstances, it will undoubtedly be necessary to make additional adjustments from time to time.

D. Current Developments Affecting D.H.I.A. Work. JOSEPH B. PARKER, Senior Extension Dairyman, U.S.D.A.

The major problem facing the D.H.I.A. program has been that of locating and training a sufficient number of replacement testers. Not only has there been no decrease in interest on the part of dairymen for the testing work, but a considerable number of new associations would have been organized if testers had been available.

Local selective service boards have been very cooperative in most cases and many testers have been deferred. In spite of this, a considerable number of testers either have volunteered for the armed services or have taken better paying jobs in defense plants. The turnover in the tester personnel has been terrific. The alternatives facing the state dairy specialists have been women testers, men over service age or with some physical handicap that would make them ineligible for military duty, boys of 18 or 19 years of age, and bi-monthly testing. All of these methods are being tested in various associations at the present time.

Another problem facing the work has been tires for testers. This has caused considerable uncertainty on the part of testers whose tires were getting smooth. A number of tire-rationing boards have now certified testers for tire recapping so that this picture is a little brighter.

The next problem to be faced by the testers will be under the gasoline rationing program. So far no reports have been received from the rationing states that testers have been unable to obtain "X" cards. If gas rationing

is extended to the whole country after July 1, as reports now indicate, an attempt will be made to obtain a ruling on the eligibility of testers for the required amounts of gas to cover their regular travel.

Sire Committee Report

B. Present-day Techniques of Artificial Insemination. GEORGE W. TRIMBERGER, Univ. Nebr., Lincoln, Nebr.

Information for this discussion on present-day techniques of artificial insemination was obtained from questionnaires sent to 64 artificial breeding associations located in 17 states. There was quite a variation in the essential techniques followed, but a study of the reports at hand indicated that the best results are obtained by using the technique described below. This is confirmed by experiments with artificial insemination at the University of Nebraska dating from 1936 to the present.

The hot water used in the artificial vagina ranges in temperature from 110 to 140° F., depending upon the individuality of the bull and the season of the year. Increasing the temperature and pressure in the artificial vagina and inserting the penis into the vagina immediately when the bull starts mounting have been found helpful if a bull fails to ejaculate. The frequency of use for the bulls is an important factor for successful operation of a breeding association and may have an influence on the breeding record as well as on the time of successful storage for the semen from a bull. Two ejaculations taken every third or fourth day with an occasional rest from sexual activity usually produces best results.

Data from the breeding associations in different states indicate little variation in the procedure followed for diluting and storing semen. Two diluters are extensively used with about equally good results. One of these, known as Phillips or Wisconsin Egg Yolk Phosphate Buffer, is described in the *Journal of Biological Chemistry*, 130: 145, 1939; and the other, which is a yolk citrate buffer containing equal parts of fresh egg yolk and a M/15 solution of sodium citrate, was suggested by Salisbury, Fuller, and Willett in the JOURNAL OF DAIRY SCIENCE, 24: 905, 1941. It is important that this egg yolk diluter be prepared as needed from fresh eggs. The eggs used in the diluter should be refrigerated soon after they are laid because if this is not done, it is believed, certain changes take place in the eggs within a few hours and these changes may be detrimental to the sperm cell. The diluter is added to the semen as soon after it is taken as is possible but not until both are of the same temperature. The ratio of dilution often is 1 part of semen to 3 parts diluter but other dilutions are used. If any diluter is used to rinse the vagina at the time of collection, it should be the same as is later used for dilution of the semen. There is a general agreement that semen should be cooled gradually but that no definite procedure is necessary to warm it before use. Various means are used to cool the samples gradu-

ally. Some technicians use double-walled test tubes; others wrap the tubes in flannel or other material; and still others prefer placing the sample tube in a jar of water large enough so that cooling takes place at the rate of 1° F. per minute when the sample is placed in the refrigerator. About 40° F. is the common storage temperature.

The preferred method for inseminating females is to use a surgical rubber glove and sleeve and hold the cervix through the intestinal wall so that the inseminating tube can be guided through it in the majority of cases. The use of a speculum often does not permit the inseminating tube to be inserted through the cervix. Experiments at Nebraska have indicated that it is best to breed in the middle or toward the end of estrus, although good results are obtained from services as late as six hours after the end of estrus, but beyond this point poor results are obtained. About 1 to 1.5 cc. of the diluted semen is usually considered a sufficient quantity for each insemination. When a 3 to 1 dilution is used, the females actually receive .25 to .4 cc. of semen. At the present time, many artifical breeding associations successfully use semen (with 50 per cent or more conceptions) that has been stored for a time interval up to 72 hours. Several subsidiary breeding associations in New York do not receive any semen that has been in storage less than 24 hours.

The keeping of proper records so that the breeding history of each service bull and female can be properly studied is important. If a bull drops below 50 per cent conceptions in the females to which he is bred, he should be withdrawn from service or used only to a limited extent. The semen from some bulls can be successfully stored for a much longer time than that from others, and the records should reveal this so that the samples can be used accordingly. It is recommended that the females be eartagged for easy and proper identification. When a female has had three services without conception, it is not advisable to breed her again until she has been given a thorough examination and the trouble diagnosed.

If the percentage of conception is not satisfactory, some change should be made to rectify the condition. Lack of sanitation and improper sterilization of instruments have been found to result in poor breeding records in several associations. Bulls with a high breeding efficiency can be selected for service, and sometimes the use of younger bulls can be justified on this basis. Storage conditions of the semen and the inseminating technique can often be improved. The health and general condition of the herds should be carefully observed. Cows in herds with Bang's disease have often been found very difficult to settle. An attempt should be made to increase the dairymen's knowledge of the phases of reproduction. Dairymen should understand, too, that a small percentage of females are non-breeders and have to be sold as sterile. Furthermore, a considerable number of females requires several services for conception. Any figure over 50 per cent of

conception in the females bred or a requirement of less than 2 services per conception can be considered a satisfactory breeding record.

C. Storing, Packaging and Shipping Semen. G. W. SALISBURY, Dept. Animal Husbandry, Cornell Univ., Ithaca, N. Y.

Eighteen of the twenty-two artificial breeding cooperatives in New York are member units of one large organization, the Central New York Artificial Breeders' Cooperative. The bulls which supply semen to the member units are all housed near Syracuse, and from that point the semen is shipped to the local inseminators of each member unit. In some cases the semen is shipped 200 miles or more, and the ejaculate collected on one morning may not reach its destination until the next day.

Semen, as handled when artificial insemination was first used in New York, could not be depended upon to maintain its fertility for more than twenty-four hours after collection. Today as a routine practice the semen is not only shipped many miles, but is often used for at least four days after collection and occasionally much longer. This change has been brought about by many factors, among which may be mentioned the use of appropriate diluters, proper cooling of the semen, development of satisfactory shipping containers so as to control the temperature of semen in transit, and development of time-saving devices which enable the operator of the laboratory to rapidly control to a large extent the quality of the semen which is shipped.

The paper which is to be presented will briefly set forth the results of four years of intensive research on certain of these problems. The application of the research findings to the solving of practical problems which arise when the semen must be assayed as to quality, properly prepared for storage, satisfactorily packaged and shipped to a relatively distant point before use, will be discussed.

Feeding Committee Report

A. Simple vs. Complex Rations for Dairy Cattle. C. F. MONROE AND W. E. KRAUSS, Dairy Dept., Ohio Expt. Sta., Wooster, Ohio.

In Ohio as in other corn belt states, corn is generally the cheapest grain for the dairy ration. Hence a simple grain mixture composed of corn and soybean oil meal, which in the past has been comparatively low in price, together with the necessary salt and minerals, offers possibilities for reducing feeding costs. From an experimental point of view, a simple grain mixture also offers possibilities for obtaining information on the value of feeds which may be added to or substituted in the mixture.

The work to be presented should be considered as a progress report rather than the final answer. In a reversal trial, twenty-eight Holstein cows,

divided into two groups, received in alternate periods of 50 days each, simple and complex grain mixtures. The simple grain mixture was made up as outlined previously and the complex mixture contained in addition to these ingredients, oats, linseed oil meal, wheat bran, beet pulp and molasses. This complex mixture had been in use previously and was considered highly satisfactory, cost excepted. These mixtures were fairly comparable in respect to digestible protein and total digestible nutrient content. Along with these grain mixtures, all the cows received a moderate amount of corn silage and liberal amounts of legume hay (fed ad lib.). The cows were milked and fed three times a day. The production level per cow was around 1200 pounds of milk and 37 pounds of butterfat per month. For this short-time trial there was practically no difference in the results from the two grain mixtures.

In a further comparison of the simple and complex mixtures other groups of Holstein cows were fed the same mixtures while on pasture for a period of 120 days. In this work the groups were not reversed but were continued on their respective rations for the full pasture season. Because the pasture consisted chiefly of legumes and hence furnished liberal amounts of protein, two other simple grain mixtures of lower protein content were fed to still other groups of cows. This pasture trial confirmed in general the results of the barn feeding trial.

As a side issue to this work, the question has arisen of whether to use ground shelled corn or ground ear corn in the simple mixture. During this last winter two feeding trials have been conducted to answer this question. The data for these trials in which a large number of cows have been used will be presented.

The comparison of simple and complex grain mixtures has been extended to calf feeding. In the calf rations the simple grain mixtures contained oats in addition to corn but no soybean oil meal. The data to be presented are based on the results obtained with 65 heifer calves from birth to 6 months of age and on 58 bull calves from birth to 9 weeks. The results with the younger animals also indicate the possibility of the simple ration.

Quality and Marketing Committee Report

B. Organization of a Quality Improvement Project. C. J. Babcock, Bureau of Dairying, U.S.D.A., Washington, D. C.

A quality improvement project for milk and cream will best accomplish the desired results if it is organized on an area plan. The area should comprise all the producers supplying an entire buying area. This plan is an indirect method of aiding the producer to improve the quality of milk and cream. Experience has shown that working directly with producers not only fails to accomplish the desired results but it is costly and time-consuming. As extension dairymen you are too busy to even attempt to contact

all milk producers in your territories. I believe, however, that most of you do have the time to assume the leadership and direction of an area project. The cooperators in such a project have been outlined by your committee chairman. Obtaining the cooperation of these parties is mainly a matter of leadership. For the most part they are familiar with the necessity for improving quality. They have realized that something should be done, but have left it to the other fellow. In the past the cooperation of the buyers of milk and cream has been the hardest to obtain. Their cooperation is essential. They are responsible for the quality of our dairy products. They are solely responsible for the quality of the milk and cream which enter into manufactured products. They have, however, often placed volume of dairy products above quality of dairy products. They have frequently judged their success by the volume handled. The result has been that they have accepted milk and cream which they knew was of a quality unfit for use. They accepted it because they knew that a competitor would accept it in order to increase his volume. There never was a more opportune time to obtain the cooperation of the buyers of milk and cream than the present. The increased demand for dairy products, which our producers are meeting with increased production, has caused a large percentage of our plants to operate to capacity. In other words, their volume complex has been, at least temporarily, satisfied. While operating to capacity is the time when they more readily respond to plans for preventing the entrance of unfit milk and cream into the channels of human consumption.

The first step in organizing a quality improvement program should be a definite outline as to what you expect to do and how you expect to do it. This outline should be discussed with the cooperating agencies and have their approval. The next step is to obtain the cooperation of all those buying milk and cream in the area chosen. Personal visits should be made to the buyers in order to arouse interest prior to calling a meeting of these men at which the project will be explained in detail. The buyers must agree to make certain quality tests on all incoming products and reject all milk and cream that does not meet an acceptable standard. Control officials should make frequent checks to determine that the quality tests are similarly conducted and the results similarly interpreted at all the plants. They should also determine that all milk and cream not meeting the acceptable standard is actually rejected. The dairy manufacturing section of the college should cooperate in determining what quality tests are used and at what point, according to the tests, the milk and cream are to be rejected. They should also cooperate when necessary by instructing plant operators how to conduct and interpret quality tests.

As soon as the program has been definitely planned and all cooperating agencies contacted the extension service should hold meetings of all the patrons selling milk or cream in the area. These meetings can probably

best be called by the dealers. At these meetings the extension service completely outlines the program. The producers are informed as to its objects and benefits. Demonstrations of the quality tests are made so as to show the difference between good and poor quality and what milk or cream will be rejected. It is explained to the producers that the results of the quality tests made at the plants are given to both the extension service and to the control officials in order that these agencies may know where best to concentrate their efforts in improving quality. It is also explained that the extension service and control agencies are going to check the buyers on the conduct of the tests to see that all producers receive equal treatment and that poor-quality milk and cream is actually rejected.

The better producers in the area should be appointed as key men to aid and advise their fellow dairymen and to take an active part in the program. These better dairymen realize the importance of quality and can be of great service to the extension service in explaining the progress of the program at meetings of producers, which should be held at frequent intervals. The appointing of key men to take an active part in the program is the best possible means of getting the producers to realize that this is their program, for their own benefit, and not something that is being forced upon them.

An educational program is continuously carried on among the producers. The extension service furnishes the material; bulletins, films, etc. Bulletins should be furnished to the producers through the county agents, the dealers, or both. Demonstrations, talks, and films on quality improvement should be left largely to 4-H dairy clubs and vocational high school students. Quality improvement of milk and cream is an ideal project for 4-H clubs. They not only make an ideal medium with which to get the message across to producers, but they are an ideal training for future dairymen.

The extension service should make full use of all the cooperating agencies as listed by your chairman. Many of these agencies have men in the field who can do promotional work for the project and assist producers with their problems. Furthermore, the cooperation of local newspapers, etc., should be obtained in order that the program may get full publicity. This publicity should start with the organization of the project, at which time the object and methods are published in detail. After the project is organized the publicity may be in the form of progress reports. Newspaper publicity not only adds impetus to the program, but it is an ideal medium for keeping those interested informed as to the progress of the program and the accomplishments.

To briefly summarize, the main duties of a dairy specialist in quality improvement work on the area plan are organization and direction. The actual producer contact is made by his cooperators and the condemnation and rejection of milk and cream are made under the direction of control

officials. Demonstrations and presentation of films, etc., are carried on by 4-H clubs and vocational agriculture schools. The extension service localizes its assistance to those actually in need of assistance as shown by quality tests and this work is largely done by the county agents. It is an opportunity to carry on a quality improvement project with less expenditure of time and effort than the average dairy specialist spends in talking quality and giving demonstrations at producer meetings. It is a project that actually shows results which can be definitely measured. During the present emergency this program should deal mainly with milk and cream for manufacturing purposes. In many localities it could be further limited to milk which is to be manufactured into lend-lease products.

C. Dairy Manufacturing Activities Devoted to National Defense. J. M. JENSEN, Extension Dairy Specialist, Michigan State College, East Lansing, Mich.

Demands on the Dairy Industry for large quantities of cheese, evaporated milk and skim milk powder for defense needs created many problems that required the assistance of specialists in Dairy Manufacturing. These problems dealt with surveys of factory output and capacity, promoting diversion from surplus areas to needed factories, determining best solution to problems arising for different localities, assisting with estimates on equipment layout and cost, pointing out the added need for quality and assisting in formulating quality programs and factory operations to that end.

Further defense activities required programs for improving milk and milk products of all classes, as a means toward furthering consumption, improving keeping properties and reducing losses.

PRODUCTION SECTION

P1. Improving Dairy-Cattle Pastures. W. B. NEVENS, Univ. Ill., Urbana, Ill.

Alfalfa, bluegrass, brome grass, winter rye, sweet clover, and a mixture of Sudan grass and soybeans grown in separate fields were combined in a rotational pasture system. Winter rye furnished an abundance of early spring pasture. The rye field was seeded in late May to Sudan grass and soybeans. The cattle were transferred from one crop to another as soon as the best part had been eaten and before the plants became too short to make a vigorous new growth.

The outstanding results of seven years' trials were: (a) The pasture season was extended from two to six weeks longer than the period of pasturing bluegrass; (b) The yields (dry-matter basis) were from two to three times as great as those from improved bluegrass pastures used alone; (c) A

good supply of green, palatable feed was maintained throughout the season; (d) The weed content of most of the pastures was much less than that of the bluegrass pastures; (e) The most important factor in improvement of yields was the selection of suitable crops and the combining of these in a rotational grazing system; (f) The second most important improvement factor was the heavy application of barnyard manure; (g) The application of cows' urine increased the protein content of bluegrass from 10 per cent to 25 per cent above that of bluegrass treated with barnyard manure; (h) The urine-treated bluegrass was more palatable than the untreated. This was found by a statistical analysis of 318 dry-matter determinations of treated and untreated bluegrass to be explained by the lower dry-matter content of the treated grass; (i) Probably the most important factor determining the palatability of dairy-cattle pasture crops is their dry-matter content. The crop lowest in dry-matter content, based on all samples taken during May to September, inclusive, over a 5-year period, was Sudan grass-soybeans. This was followed in order by winter rye, alfalfa, brome grass, sweet clover, and bluegrass. Of 389 bluegrass pasture samples, 92 per cent contained more than 30 per cent dry matter, while only one of 38 Sudan grass-soybean pasture samples was higher than 30 per cent in dry matter content.

P2. The Ability of Yearling Heifers to Withstand Cold Temperatures.

J. R. Dice, Dept. Dairy Husbandry, North Dakota Agricultural College, Fargo, N. Dak.

Work done at this station which we have previously reported[1] indicated that: (a) dairy cows can withstand exposure to cold temperature; (b) that they will produce practically the same in a cold stable as they will in a stable where the temperature is about 50° F.; (c) that milk cows on full feed, when housed in a cold stable produce sufficient surplus heat over usual maintenance requirements to maintain body temperatures without using nutrients for that purpose; (d) that cows housed in a cold shed require no more protein and total digestible nutrients for milk and butterfat production than other cows or the same cows when kept in a standard dairy barn; (e) that the cows in the cold shed tend to gain somewhat more body weight than the cows in the dairy barn.

We have housed yearling heifers in an open shed where the average temperatures were below freezing and another group in a closed shed where the temperatures were usually above freezing. The data accumulated to date indicate that the heifers in the closed shed average to put on more weight, and grow more as indicated by the gain in height at withers than the heifers in the open shed. Results obtained during two seasons confirm

[1] Dice, J. R. The Influence of Stable Temperature on the Production and Feed Requirements of Dairy Cows. Jour. Dairy Sci., 23, No. 1: 61–69. 1940.

definitely the above statement. Results obtained during the third year do not. Averages indicate that the heifers in the closed shed made the best gains in skeleton growth in each of the three years and the best gains in weight during two of the three years.

This is to be considered as a progress report as the project is to be carried on at least through two more seasons.

P3. Resting Maintenance Cost in Growing Dairy Cattle.* S. Brody, H. H. Kibler, and A. C. Ragsdale, Dept. Dairy Husbandry, Univ. Mo., Columbia, Mo.

The manner in which resting maintenance cost (resting energy metabolism measured by rate of O_2 consumption) of Jersey and Holstein cattle varies with increasing age and body weight is graphically illustrated. Prior to about five months, the metabolism tends to vary directly with body weight (about 24 cal./pound/day); following this age, the metabolism varies not with $W^{1.0}$, but with $W^{0.6}$, meaning that increasing body weight one per cent increases maintenance cost only about 0.6%. From the surface-area viewpoint, the metabolism per square meter rises from birth until age of "natural weaning" (5 to 6 months) and remains approximately constant thereafter.

P4. The Occurrence and Importance of Still-unidentified Nutrients in Milk and Milk Products. A. M. Hartman and C. A. Cary, Division of Nutrition and Physiology, Bureau of Dairy Industry, U.S.D.A., Washington, D. C.

Young rats nursed by mothers fed a diet of hot-alcohol-extracted casein, dextrin, yeast, cottonseed oil, cod-liver oil, agar, and a salt mixture did not grow normally when continued, after weaning, on this diet or on this diet containing additional yeast (bakers' or brewers') or supplemented with an average daily dose of thiamin chloride 40 μg., riboflavin 40 μg. or 160 μg., pyridoxine hydrochloride 40 μg., nicotinic acid 0.5 mg., calcium pantothenate 0.5 mg., inositol 0.5 mg., para-aminobenzoic acid 3.0 mg., choline chloride 6.0 mg., or biotin methyl ester 1.0 μg., or by vitamins E (alpha-tocopherol) 50 μg. or K (2-methyl, 1,4,-napthoquinone) 12.5 μg.

The rate of growth may be increased 90 per cent or more by replacing the extracted casein with commercial casein or by feeding various liver extracts separately from the basal diet. Feeding a liver fraction which furnished only 0.2 mg. of solids daily produced decided growth. In paired feeding experiments (still in progress), males which have been fed, separately from the basal ration, a quantity of liver extract that furnished an insignificant amount of metabolizable energy, have grown more than sex-litter mates on the basal ration alone. The average difference is not large

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station, Journal Series No. 833.

but it is statistically significant. Accompanying the increased rate of body growth of females fed liver extracts were earlier vaginal patency and marked increases in the weights of the ovaries, the uterus and the adrenals; similarly with males, marked increases were observed in the weights of the seminal vesicles and prostate the epididymis and the thymus.

Practically colorless, active liver extracts have been prepared; synthetic xanthopterin was inactive; and the growth-promoting material in the liver preparations was not precipitated by ammoniacal silver nitrate as is xanthopterin. The factor in liver extracts resembles pyridoxine in some of its chemical properties. Aqueous solutions of a liver extract, adjusted to pH's 3, 7, and 11 and then autoclaved at 18 pounds pressure for 3 hours, remained active but possibly suffered some loss in activity in each case. Fresh whole milk, cheeses (cottage, Swiss, Cheddar), beef muscle, and lettuce promoted growth when fed in addition to the above basal diet; commercial dried skim milks had a similar effect.

P5. Hydroxyamino Acids of Milk Proteins. B. H. NICOLET, L. A. SHINN, AND L. J. SAIDEL, Division of Nutrition and Physiology, Bureau of Dairy Industry, U.S.D.A., Washington, D. C.

The discovery that periodic acid reacts with amino alcohols has led to the development of satisfactory methods for the determination of serine and threonine, and also to a demonstration that hydroxy glutamic acid probably does not occur in milk proteins.

The use of these methods has made it possible to show that serine and threonine, in protein combination, have a special sensitivity to alkali analogous to (but less than) that of cystine. Seryl residues, for instance, are dehydrated to give dehydroalanyl residues, the structure of which is clearly shown by their ability to add substances of the type RSH to form cysteyl derivatives.

When a protein containing such residues is subsequently submitted to acid hydrolysis the nitrogen in them comes off as ammonia.

P6. Utilization of Urea by Calves Less than Four Months of Age. J. K. LOOSLI, C. M. MCCAY, AND L. A. MAYNARD, Cornell Univ., Ithaca, N. Y.

Holstein calves receiving whole milk were given a diet of yellow corn 20 parts, corn starch 33, chopped timothy hay 30, cane molasses 10, bone meal 2, salt 1 and urea 4 parts, as soon as they would consume dry feed. The calves continued to grow at a fairly normal rate after the milk was removed from the diet at 7 weeks of age. Calves fed the basal diet without urea failed to increase in body weight after milk feeding was discontinued. Digestion trials and nitrogen balance studies were made when the calves were 3 to 4 months of age. Calves fed the low-protein basal diet were in

negative nitrogen balance, while calves fed the basal diet plus urea were able to store nitrogen.

One-half of the calves were fed a daily vitamin supplement consisting of thiamin, riboflavin, calcium pantothenate, crystalline vitamin K, pyridoxin, p-amino benzoic acid, nicotinic acid, choline, and crude mixed tocopherols. Supplements of these B-vitamins had no apparent influence upon the growth rate of the calves, the efficiency of nitrogen storage, nor the riboflavin content of the organs and edible meat of the calves.

P7. The Feeding of Korean Lespedeza Seed as a Protein Supplement for Milk Production.* H. A. HERMAN AND A. C. RAGSDALE, Dept. of Dairy Husbandry, Univ. Mo., Columbia, Mo.

Chemical analyses of Korean lespedeza seed show a striking similarity in protein content to that of the high protein feeds such as cottonseed meal, soybean oil meal, and linseed oil meal, commonly used in balancing dairy rations throughout the middlewest. It is estimated that over 7,000,000 acres of Korean lespedeza is annually grown in Missouri. This legume annually seeds itself and is grown on soils of wide variety over the entire state. Only about 200,000 acres are annually harvested for seed as yet. The annual seed production is approximately 400 lbs. per acre on the average, but may be as much as 800 lbs. per acre. With this vast supply of a relatively cheap source of protein available, and in view of preliminary experiments at the Missouri Station indicating that the ground seed might serve in the rations for lambs and poultry, an experiment of the alternate feeding trial plan was conducted, using two groups of 10 dairy cows each, to determine the value of the ground seed as a substitute for cottonseed and soybean oil meal in the ration of milking cows. The cows in each group were comparable as to body weight, stage of lactation, and daily milk yield.

Each feeding trial consisted of a 40-day period with a 10-day preliminary period. The cows were fed alfalfa hay and sorgo silage as a source of roughage and grain in accord with daily milk production. The average daily milk yield was 35 lbs. per cow on two-times-a-day milking.

The lespedeza seed used was finely ground and mixed into a ration so as to give the same protein content as a ration containing 7½ per cent choice cottonseed meal and 7½ per cent soybean oil meal as the main source of protein.

The seed used gave the following analyses: total dry matter 92.48%, crude protein 34.5%, crude fiber 9.5%, ether extract 7.93%, nitrogen-free-extract 34.13%, ash 6.42%. The grain mixture fed to each group averaged 13.8% crude protein.

In the first 40-day feeding trial following a 15-day preliminary trial,

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the ten cows fed ground Korean lespedeza seed as a source of high protein averaged 32.68 lbs. of milk daily, whereas the group of cows receiving a ration with the protein supplement made up of equal parts of soybean oil meal and cottonseed oil meal averaged 32.67 pounds daily. At the end of the first 40-day trial, the groups were reversed as to grain ration fed and the group formerly fed Korean lespedeza seed were fed the soybean oil and cottonseed oil supplements. The second trial, following the usual 10-day preliminary period between trials, resulted in the 10 cows receiving the lespedeza seed supplement averaging 27.74 pounds of milk daily. The control group averaged 27.34 lbs. daily. The average per cent of fat in the milk produced by the two groups was the same, or from 3.7 to 3.8 per cent fat.

The amount of grain feed, silage, and hay fed the two groups was approximately equal and was carefully controlled. The cows maintained their body weight and were in good physical condition, on both rations. The ground Korean lespedeza seed mixture was eaten readily and seemed to in no way affect the palatability of the grain ration.

These trials indicate that the proteins of ground Korean lespedeza seed are equal, pound for pound, to the proteins of a mixture of equal parts of cottonseed oil meal and soybean oil meal in the ration of lactating cows.

The use of Korean lespedeza seed as a protein supplement in the usual dairy rations, fed over a long time period, is now under investigation at the Missouri Station.

P8. The Biological Values of Lespedeza, Alfalfa, Corn and Milk Proteins for Growing Dairy Heifers.* ERIC W. SWANSON, H. A. HERMAN, AND A. C. RAGSDALE, Dept. of Dairy Husbandry, Univ. Mo., Columbia, Mo.

Korean lespedeza has become the major legume forage crop grown in Missouri and several surrounding states. Under favorable conditions a profitable yield of lespedeza seed may also be harvested. The nutritive value of the proteins of lespedeza hay was compared with that of alfalfa hay proteins and an attempt was made to determine if a supplementary effect existed between lespedeza hay proteins and milk and corn proteins respectively. Since lespedeza seed may be used as a protein supplement feed, the biological value of its protein was also investigated.

The biological values were determined with dairy heifers by application of Mitchell's method. Eight fifteen- to eighteen-months-old purebred Holstein heifers were used in the nitrogen metabolism trials. Endogenous urinary nitrogen and fecal metabolic nitrogen were determined by feeding a low protein ration of oat straw, corn starch, sugar, and minerals. Feces and urine were collected separately by a mechanical continuous collecting appa-

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station Journal Series No. 843.

ratus, sampled aliquotly each day, and the preserved composite sample was analyzed. All preliminary and collection periods were ten days. The protein content of all rations (except one lot of lespedeza hay) was adjusted to 10% total crude protein by adding sugar and starch.

A preliminary trial early in 1941 with four heifers gave average values of 77% for the biological value of alfalfa protein, 87% for lespedeza hay protein, 76% for corn protein, and 85% for a mixture of corn and lespedeza. Fourteen per cent of the protein of the latter ration was from corn, 85% from lespedeza. No supplementing effect of the corn and lespedeza proteins was apparent.

The trials were repeated, 1941–42, with four different heifers and different lots of hays. Average biological values (percentage of absorbed nitrogen retained by the body) obtained in the second trial were 88.6% for one lot of lespedeza hay, 84.5% for a second lot of lespedeza hay, 73.4% for alfalfa hay, 70.3% for milk protein added to oat straw, 74.0% for lespedeza seed added to oat straw, and 84.1% for a mixture of the first lot of lespedeza hay and dried skim milk such that 33% of the protein was furnished by milk and 66% by the hay. This figure indicates a very slight supplementing effect of the proteins but not a significant one.

The digestibility of the protein of the lespedeza hay rations was much lower than that of any of the other rations. There was an inverse relation between the biological values and the digestibility of the nitrogen of the rations which resulted in practically identical net utilization (biological value times digestion coefficient) of the protein of all the rations. The average percentage of nitrogen intake stored was 22.6% on the first lespedeza hay ration, 24.6% on the second, 20.8% on the alfalfa hay, 27.6% on the lespedeza and milk ration, 22.2% on the milk ration and 21.9% on the lespedeza seed ration. There was no statistically significant difference between any two rations in percentage of ingested nitrogen stored.

The results indicate that although the lespedeza hay protein was not digested as well as alfalfa, corn, milk protein, or lespedeza seed protein, the digested protein was utilized to a greater extent by growing dairy heifers with the result that the net utilization was the same for all the rations as they were fed in this investigation.

P9. A Comparison of Acetic Acid, Fed as Triacetin, with Glucose as a Nutrient in Feeds. T. B. McManus and C. B. Bender, N. J. Agr. Expt. Sta., New Brunswick, N. J.

Two experimental rations, the first containing 15% glucose and the second an equicaloric amount of acetic acid in the form of triacetin, were fed to albino rats using the paired feeding method of controlling food intake. The efficiency of the two rations was compared through several measurements.

A six-week study of the growth rates of the rats was made. This showed

that the rations were equally efficient in maintaining the animals and supporting growth. A study of the heat production of the animals receiving the two rations showed no difference in their effect on the rate of metabolism. The metabolizable energy of the two rations was determined. The gross energy of the glucose-containing ration was 94.5% metabolizable and that of the triacetin containing ration was 94.3% metabolizable. A study of the loss of volatile acids in the urine of the animals showed that the acetic acid of the triacetin-containing diet was retained.

The results show that the two rations were equivalent. Acetic acid, fed as triacetin, was absorbed from a balanced ration and retained by the animal. It was as effective in supporting growth as an equicaloric amount of glucose and it had no greater effect on the specific dynamic action of the ration than did glucose.

It is concluded that acetic acid, in the form of triacetin, was utilized with a degree of efficiency equal to that of glucose.

P10. Ruminal Gases in Normal and Bloated Animals. T. M. Olson, S. Dak. Agr. Expt. Sta., Brookings, S. Dak.

Bloat in cattle has been known among livestock men for a long time. It has also been recognized that some plants, particularly legumes, cause bloat more readily than non-legumes.

The immediate cause of bloat is assumed to be a rapid formation of gases in the rumen. The assumption is that the gases accumulate in the rumen to the point where the extension of the rumen exerts sufficient pressure on the diaphragm to interfere with the normal functioning of the heart and lungs. The gases concerned were thought to be carbon dioxide and methane, although no published data were available until very recent years to indicate that these gases had been determined in a laboratory.

Inasmuch as the cause of death from bloat is attributed to excessive pressure on the vital organs it is important to know what this pressure is, and whether it is sufficient to produce the results claimed. Pressures have been determined at the South Dakota Station on a number of bloated animals and animals which have died from bloat, and found to range between 60–70 mm. of mercury above atmospheric pressure. Other animals have been insufflated with air from a compressor up to 90–100 mm. of mercury with no ill effects except discomfiture of the animal. As soon as the pressure was released no after effects were observable.

In more recent years analyses have been made of ruminal gases, which indicate that in addition to carbon dioxide and methane two additional gases, viz., carbon monoxide and hydrogen sulphide, are also present in the ruminal gases. These gases are present in varying amounts in the rumen of bovine on normal dry feeds. It has also been determined that the quantity of these gases will vary with individuals on the same feeds, and with the kind of feeds eaten by the animal.

Recent experimental work indicates that when animals bloat, there is considerable increase in hydrogen sulphide gas, as compared to animals on dry feed. The amount of hydrogen sulphide gas may be ten to twenty times that of animals on dry feed.

Toxicologists have known for some time that hydrogen sulphide gas is highly toxic. Small amounts of this gas when absorbed into the blood stream is fatal. Recent laboratory determinations have demonstrated that alfalfa under certain stages of growth is very high in hydrogen sulphide gas. This seems to indicate that this gas plays a significant role in the cause and death of bovines from bloat.

P12. Further Nutritional Studies on Calf Scours. NORMAN S. LUNDQUIST AND PAUL H. PHILLIPS, Univ. Wis., Madison, Wis.

Previous work at this Station has shown that calf "scours" in many cases is of nutritional origin. Recent studies have yielded data which further clarify the early dietary requirements of the calf. New-born Holstein calves can be satisfactorily raised on a properly fortified skim milk diet without access to colostrum. This has not been accomplished with Guernsey calves. Colostrum feeding for three days followed thereafter by a properly fortified skim milk diet was found to be a satisfactory diet for the calves of all breeds used. It has been found that ascorbic acid is necessary in adequate amounts in the early diet of the calf to prevent and control navel infection. Ascorbic acid can be administered per os for the first 10–12 days of life, thereafter, it must be injected to be effectively recovered in the blood stream. Blood plasma ascorbic acid in the normal calf diminishes from birth to the third week of life, then gradually returns to a normal level of approximately .3 mg. %. These observations seem to be closely related to the initial functional activity of the paunch. These studies further emphasize the point that both vitamin A and certain members of the vitamin B complex are required by the calf for the control and prevention of scours. In nutritional scours, certain members of the vitamin B group are indicated when the blood plasma vitamin A concentration is above .10γ/cc. and vitamin A administration is required either alone or in combination with these B vitamins when the blood plasma vitamin A is below this level. It has been shown that pantothenic acid alone was ineffective. The addition of nicotinic acid (alone) to the milk diet was distinctly beneficial for the control of scours when adequate vitamin A was present.

P13. Factors Affecting the Vitamin A and D Potency of Alfalfa Hay.* G. C. WALLIS, Dairy Dept., S. Dak. Agr. Expt. Sta., Brookings, S. Dak.

The importance of good quality roughages in maintaining the health and

* South Dakota Agricultural Experiment Station, Journal Series 164.

productiveness of livestock is becoming increasingly evident. In this study the factors and methods concerned with (1) the rapidity of moisture loss, (2) the conservation of vitamin A values, and (3) the development of vitamin D activity in the curing and storing of alfalfa hay are under investigation. When these fundamental principles are understood, effective methods of making and keeping alfalfa hay and other roughages of high nutritive quality can be devised and evaluated. Thus far studies have been made on a third cutting of alfalfa cured in the swath and windrow, and on two second cuttings each cured simultaneously in swath, windrows, and cocks. Some studies have been made on losses during winter storage under hay mow conditions.

According to the present information when hay is cured in the swath and in small windrows from immediately after cutting the moisture loss is most rapid from the swath for only about the first half day. By the end of the day there is less moisture in the small windrow and this relationship continues from then on. Most rapid drying can be secured by leaving hay in the swath for a half day, then raking it into small windrows. Turning the windrow after the hay is $\frac{1}{2}$ to $\frac{2}{3}$ dry may still further hasten the drying process.

For the first day there is not so much difference in the rate of destruction of carotene in the swath and small windrow, but after that the destruction in the swath is more rapid so that by the time the hay is ready to haul the small windrow may have up to twice as much carotene as that cured in the swath. Carotene analyses of hay which was cured out completely in the cock without spoiling are not yet available for comparison.

Vitamin D analyses are available for the third cutting samples and for one of the second cutting series of samples. This evidence indicates that it takes from 2 to 4 days of good sunshine exposure to develop the maximum amount of vitamin D in the hay. The vitamin D development was very similar in the swath and small windrow but there was little or no additional development in the cocks beyond the .23 I.U. of vitamin D per gram of air dry material at the time of cutting. There is some evidence that light showers tended to destroy some of the vitamin D which had been previously developed in the hay. The third cutting hay cured under September sunshine developed up to 5 International Units of vitamin D per gram whereas the second cutting cured under similar conditions of July sunshine failed to develop more than 1 International Unit per gram. Whether this was due to the presence of more activatable material in the third cutting hay or to some other cause and whether or not it will prove to be the general experience is not known at the present time.

In 5 months of storage in the mow swath cured hay with a carotene content of 88 micrograms per gram of dry matter dropped to 16 micrograms and hay cured in a small windrow dropped from 158 to 28 micrograms per

gram. There was a further slight loss in both hays during the next three months of storage. There was some evidence of a slight loss in vitamin D during the first 5 months but none in the succeeding 3-month period.

P14. The Vitamin A and Carotene Content of the Blood Plasma of Calves from Birth to Four Months of Age. L. A. MOORE,* Maryland Agr. Expt. Sta.

The question of the vitamin A requirement of calves from birth to four months of age has not been widely investigated although this is the most difficult period of the calf's life. It was thought that the determination of the vitamin A and carotene content of the blood plasma of calves of this age group under the usual conditions of herd management might throw some light on the subject from the practical point of view.

Samples of blood were collected from 12 calves before they had colostrum and at 24-hour intervals up to one week of age. Samples were also taken every two weeks on about 50 dairy calves and 20 beef calves up to four months of age.

The vitamin A and carotene content of the blood plasma of a new born calf is very low. These data show that after taking colostrum the plasma vitamin A of dairy calves increased markedly and the carotene increased slightly up to the third day when the calves were removed from the cow.

The blood plasma of Jersey and Guernsey calves from birth to 4 months of age contained as much vitamin A as that of Holstein and Ayrshire calves.

Under the usual conditions of herd management it was found that the blood plasma from beef calves contained twice as much vitamin A as the blood plasma from dairy calves. This raises the question as to whether dairy calves raised under a system of reduced milk intake as is usually practiced on most dairy farms receive sufficient vitamin A and carotene from birth to four months of age.

It was found that the feeding of a good quality of lespedeza hay very markedly increased the vitamin A and carotene content of the blood plasma of dairy calves after about one month of age above that of calves receiving a good grade of alfalfa or clover and timothy.

P15. Vitamin C in Dairy Cattle Nutrition.† G. C. WALLIS, Dairy Dept., S. Dak. Agr. Expt. Sta., Brookings, S. Dak.

In the course of our studies on the vitamin D deficiency of dairy cows some symptoms were noted which indicated the possibility of a complicating

* The data to be presented were collected from the college dairy and beef herds of the Michigan State College and the dairy herd of the University of Maryland.

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† South Dakota Agricultural Experiment Station, Journal Series No. 163.

vitamin C deficiency. As these animals had been on a ration which was also low in vitamin C for three years or so it was thought advisable to investigate this possibility.

The vitamin C in the blood plasma and the milk was determined twice monthly for a period of a year to see if the vitamin was available for physiological purposes and for secretion into the milk. For comparative purposes, similar determinations were made on the three other groups of cows receiving rations which provided increasing amounts of vitamin C. One of these groups consisted of experimental cows receiving alfalfa hay and a grain mixture and the other two groups were taken from the college herd. Of the latter, one group received alfalfa hay, corn silage, and a grain mixture while the other received pasture supplemented with grain which would supply a rich source of vitamin C. The indophenol titration method was used for these vitamin C determinations.

The vitamin C content of the blood plasma varied on the average between 0.3 and 0.4 milligrams per 100 ml. with no appreciable differences between the groups. The experimental cows on the vitamin C low ration were even a little higher in this respect than the cows receiving a large intake on pasture. The vitamin C content of the milk was also quite constant at about 18 to 20 milligrams per liter and showed no significant differences between groups of cows or between morning and evening samples.

Six vitamin C balance trials have also been carried out on the experimental cows receiving the vitamin C low ration, and varying in milk flow from dry cows to those in heavy production. In this case the vitamin C in the feed, feces, and urine was determined by the use of a photoelectric colorimeter and the indophenol dye. In all cases the outgo was decidedly larger than the intake. The outgo in the urine was very small in comparison to that of the milk and feces. For instance, in one case the daily intake was 73 milligrams and the outgo in 49.5 pounds of milk was 526 milligrams, in the feces 703 milligrams, and in the urine only 19 milligrams. The total outgo was 1248 milligrams. Such decidedly large outgoes as compared with the intake over long periods of time gives strong evidence of an active vitamin C synthesis by dairy cows. The large outgo in the feces compared with the urine suggests a synthesis along the gastro-intestinal tract although the appearance of appreciable amounts of vitamin C in the milk indicates a rather free absorption into the blood stream with possibly a re-excretion into the intestinal tract. Of course it could be synthesized elsewhere in the body and be excreted via the intestinal tract rather than the kidneys.

P16. Carotene (Provitamin A) Requirements of Dairy Cattle for Conception. A. H. KUHLMAN AND W. D. GALLUP, Oklahoma A. and M. College, Stillwater, Okla.

The minimum daily carotene requirement of dairy cows for normal

reproduction appears to be between 40 and 45 micrograms per pound body weight. The carotene requirements of first-calf heifers may be somewhat higher than those of older cows since the former animals need carotene for growth in addition to that needed for maintenance and reproduction. Apparently the amount of carotene needed for lactation is not in excess of that required for successful reproduction. The level of carotene intake required to maintain fertility of cows is not known.

Records of the intake of carotene previous to breeding are available for 27 grade Jersey females for a total of 80 services and 58 conceptions. With the exception of several cases in which Puratene (a commercial carotene supplement) was also used, prairie hay was the sole source of carotene. The average daily intake of carotene per pound body weight for the 90-day period preceding service varied from 20 to 353 micrograms.

Forty-three of the 58 conceptions resulted from the first service, 12 from the second, and one each from the third, fourth, and sixth services. For the entire group 1.38 services were required per conception. In 21 cases in which cows had an average daily intake of 20–39 micrograms carotene per pound body weight for the 90-day period preceding service, 1.99 services were required per conception. When the daily carotene intake was 40–59 micrograms, 60–99 micrograms, and 100–353 micrograms, 1.35, 1.15, and 1.23 services per conception were required respectively in 23, 15, and 21 cases.

While the results obtained do not establish the minimum carotene requirements for conception, they do indicate that a very satisfactory conception rate was obtained when the carotene intake was at the same level as that required for normal calving.

P17. The Relation of Nutrition to Breeding Performance in Dairy Bulls.

I. R. Jones, J. R. Haag, and R. W. Dougherty, Oregon Agr. Expt. Sta., Corvallis, Oregon.

In a study to determine the effect of the ration on fertility, 18 bulls were fed experimentally from birth to 31 to 40 months of age as follows:

Group A. Four bulls. Good quality alfalfa hay after seven months of age and free access to disodium phosphate.

Group B. Two bulls. Same ration as Group A supplemented daily with 1 pound each of skimmilk powder and oat groats.

Group C. Four bulls. After 3 months of age weathered hay bleached until practically devoid of green color and about 3 pounds daily of a mixture of oats, barley, skimmilk powder, linseed meal, wheat bran, bone flour and salt.

Group D. Two bulls. Same ration as Group C supplemented daily with approximately 2 ounces of salmon oil containing about 5000 U. S. P. units of Vitamin A per gram.

Group E. Four bulls. Plain dried beet pulp as the only roughage. After 90 days about 3 pounds daily of a mixture made up of 66 per cent corn gluten meal, 30 per cent skimmilk powder, 2 per cent each of bone flour and salt. Approximately 10 cc. of salmon or cod liver oil was fed daily.

Group F. Two bulls. Same ration as Group E supplemented with 10 cc. of wheat germ oil fed on the grain once weekly.

Salt and bone flour was available to the bulls at all times and iodine was supplied to all animals once weekly in the form of potassium iodide solution.

Group B animals made normal growth followed by Groups E and F whose gains were almost identical and only slightly below normal, Group A from 10 per cent to 15 per cent below normal until 2 years of age, Group D averaging about 20 per cent below normal from 6 to 18-month period and Group C averaging 25 per cent below normal during the 6 to 18-month period. After about 18 months of age the animals below normal grew at an accelerated rate so that at the time of disposal growth differences between the groups were largely eliminated.

The results of 299 semen examinations showed considerable variations among the individual animals and with the same animal at different times. Some of the bulls showed remarkably constant sperm counts, motility ratings and kind and percentage of abnormal forms. Several animals would have been rated as questionable breeders on the basis of low sperm counts and volume, poor motility, variable pH readings and 25 to 40 per cent abnormal forms. However, there appeared to be no particular relation between so-called low quality sperm and the rations fed.

The fertility of 17 of the bulls was proven by service to 303 cows. At the present writing pregnancy and calving records are complete on 181 cows which averaged 1.40 services per conception. Of the calves born 168 were normal, 5 were weak or dead at birth and 8 pregnancies resulted in abortions.

A study of the individual bull and group records shows some individual but no large group variations from the average. Only one bull averaged more than 2 services per pregnancy. Apparently a ration adequate for fairly normal growth to 3 years of age in a dairy bull is satisfactory for normal reproductive performance.

Other data taken during the course of the investigation included blood carotene values, blood phosphorus determinations and ascorbic acid content of the semen. Following slaughter the testes of the bulls were sectioned. Preliminary histological studies indicate no outstanding differences in spermatogenesis and interstitial tissue development with the bulls fed different rations.

P18. Some Preliminary Results of Feeding Chloretone to Bulls. E. C. Scheidenhelm, A. L. Bortree, C. F. Huffman, and C. F. Clark, Michigan State College, East Lansing, Mich.

Sterility in dairy bulls has been a vital problem to dairymen for years.

In 1941 Phillips and coworkers at the University of Wisconsin reported that the subcutaneous injection of ascorbic acid into sterile bulls resulted in marked increase in breeding efficiency. Bortree and associates in 1941 found that the feeding of chloretone to cattle increased the blood plasma ascorbic acid level. The feeding of 5 grams of chloretone per day resulted in an increase in plasma ascorbic acid, usually within 5 days.

In the present investigation the effect of feeding chloretone at various levels for different periods of time was studied as well as the effect upon sex interest and breeding efficiency of sterile bulls.

Two 1800-pound bulls were each fed 10 gms. of chloretone per day. One of these bulls lost its sense of balance after 38 days due to the anesthetic effect of chloretone. The other bull was normal. The amount of chloretone fed per day to these two bulls was reduced to 5 gm. at this time and continued for a period of 4 months with no ill effects.

Three slow breeding bulls were used to determine the effect of feeding chloretone upon sex interest. The first bull required 10 to 15 minutes to serve a cow before treatment. There was continuous improvement in sex interest after chloretone feeding, until at the end of the fourth month this bull served a cow immediately. The second bull which failed to serve a cow during a one-hour period before treatment, responded to chloretone feeding as was indicated by a service in 5 minutes following 3 weeks' treatment. A third bull that required 10 to 15 minutes per service prior to chloretone feeding, bred a cow in 3 to 4 minutes after 3 weeks' treatment.

The effect of chloretone administration upon the number of services per conception was investigated using three bulls. The first bull required 5.33 services per conception during 7 months previous to the feeding of chloretone. During the 6 weeks following chloretone feeding the number of services per conception was 1.50. The second bull which showed 8 services per conception during a 2-month period prior to treatment, required 2.33 services per conception for the same period following chloretone treatment. In case of the third bull 8.5 services per conception were required during the 2 months prior to treatment, while only 2.66 services per conception were needed during the three months following the feeding of chloretone.

Additional studies on these problems are in progress and will be reported later.

P19. Effect of Amphyl on Bull Sperm. H. O. DUNN, C. E. SHUART, AND O. F. GARRETT, N. J. Agr. Expt. Sta., New Brunswick, N. J.

Amphyl is the trade name of a concentrated disinfectant consisting of a mixture of p-chloro-s, m-dimethyl hydroxybenzene, p-tert amyl hydroxybenzene and neutral soap dissolved in alcohol, glycerol and water. It has a phenol coefficient of 10 but is practically non-corrosive to animal tissue.

In a search for a substitute method for heat sterilization of the equipment

used in artificial insemination, Amphyl was tried. In 10 trials it was found that possible disinfectant residues left in the glass tubes, used for receiving the ejaculate, after treatment with Amphyl had no effect on the longevity or motility of the sperm. To make the test more severe, Amphyl, in various concentrations, was added directly to semen and the longevity and motility of the sperm were observed. The semen was usually diluted with an egg yolk-phosphate buffer solution.

Addition of Amphyl to undiluted semen destroyed all sperm within 30 seconds. Addition of the disinfectant to semen diluted only with the phosphate buffer rapidly destroyed the sperm. When 0.2% to 0.5% of Amphyl was added to semen diluted with the egg yolk-phosphate buffer solution, however, the sperm lived from 4 to 9 days longer than sperm in the same diluted semen but containing no Amphyl. In one trial, for example, all sperm in the control semen were non-motile by the sixth day, whereas, 30% of the sperm in the Amphyl-treated semen were still motile on the thirteenth day.

The rate of the destruction of bacteria in the control semen was about the same as that in the Amphyl-treated semen.

P20. The Relation of Morphology to Fertility in Bull Semen. G. W. Trimberger and H. P. Davis, Nebr. Agr. Expt. Sta., Lincoln, Nebr.

The morphological characteristics of the spermatozoa in the semen from 24 dairy bulls of the Holstein, Jersey, Guernsey, and Ayrshire breeds used for service in the University of Nebraska dairy herd were observed regularly at monthly intervals over a period of several years for a total of 376 months. The numbers of normal and abnormal sperm cells were determined by counting one thousand cells after they had been stained. When all samples were included, the 24 bulls averaged 790.5 normal cells per thousand with a range from 276 to 968 for individual samples and from 373 to 903.4 from the lowest to the highest average for a bull. The breeding efficiency was 57.76 per cent conception in the 483 cows bred during the experimental period.

No differences were found in the number of normal sperm cells in semen samples obtained by the massage method per rectum compared to those obtained with an artificial vagina from the same bulls nor was there any definite relation between any particular abnormal form and decreased breeding efficiency. Free heads or heads without tails was the most common abnormality found among the cells, with broken tails and looped tails ranking next in order. A monthly tabulation for seasonal variation showed some fluctuation in the number of normal spermatozoa but no significant differences were found.

Bulls with over 900 normal sperm cells per thousand had significantly better breeding records than those below this high level, and 8 of the 24 bulls sampled or 33.33 per cent had a month or more with over 900 normal

cells per thousand although only 11.44 per cent of all samples were of this high quality. A total of 71 cows were inseminated with semen taken from bulls during a month in which they had over 900 normal sperm cells per thousand and 53 or 74.65 per cent of these cows conceived. From 76 cows bred with semen from bulls during months in which they had from 851 to 900 normal cells per thousand, the result was 48 or 63.16 per cent conceptions. There was relatively little difference between the breeding records of bulls with 500 to 850 normal sperm cells per thousand divided by class intervals of 50 and all but one class averaged 50 per cent or more conceptions, but the average for 325 cows bred was 51.08 per cent conceptions. Bulls with less than 500 normal cells per thousand had very poor breeding records.

Comparison of the first and second ejaculate showed a slight advantage in favor of the second but no significant differences when the previous service had been within 20 days. A marked and significant difference was found if the previous service was not within the 20 day limit. This difference was more pronounced when the previous sample had been taken between 20 and 30 days than when the time interval between samples was over 30 days because after a long rest period more than two ejaculates are necessary to return to normal. This suggests the advisability of taking two or more services from a bull if he has not been used for several weeks.

P21. Studies of Respiration Rate of Dairy Bull Spermatozoa.* RAY E. ELY, Dept. of Dairy Husbandry, Univ. Mo., Columbia, Mo.

The relationship between the average number of services per conception and respiration rate of dairy bull spermatozoa has been reported. Other characteristics of an ejaculate, such as initial motility, percentage of abnormal spermatozoa, and survival on storage have been correlated with the bull's fertility or breeding record.

In this investigation a study was made of the oxygen consumption of dairy bull spermatozoa and the relation to other characteristics of the ejaculate. The bulls used represent wide variation in their breeding records and physical and chemical characteristics of the ejaculates.

Samples were collected with an artificial vagina with precautions to avoid temperature shock and were held at a standard temperature until the respiration determinations were begun. In all cases the first readings were taken between 90 and 120 minutes after the ejaculate. A modified Barcroft-Warburg respirometer at 37° C. was used for measurement of oxygen consumption. Measurements were made in a buffered seminal fluid medium either by dilution with phosphate buffer or removal of one-half the seminal fluid after centrifugation and making up to volume with phosphate buffer. A staining technique for differentiation of living and dead

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station Journal Series No. 842.

spermatozoa was used for calculating the results on the basis of number of living spermatozoa as well as total number of spermatozoa.

Samples maintaining a 2 motility rating an average of 156 hours on storage at 40° F. had over twice the oxygen consumption of samples surviving less than 24 hours on storage. Intermediate samples in length of survival on storage were intermediate in volume of oxygen consumption. There was a closer relation between the survival time of individual samples and respiration rate than of the average survival time of a given sire's ejaculates and his average respiration rate.

Three groups of samples according to their per cent of abnormal spermatozoa had a decreasing oxygen consumption with increasing numbers of abnormal spermatozoa.

Centrifuging lowered the oxygen consumption of the sperm suspension as compared to control samples; however, the number of living spermatozoa was also decreased, while oxygen consumption per billion living spermatozoa remained essentially the same.

Addition of seminal fluid caused a stimulation of oxygen uptake above the rate of washed spermatozoa in phosphate buffer. The increase was much greater than accounted for by the oxygen uptake of the seminal fluid alone.

The oxygen uptake of the seminal fluid represented quite wide ranges in the percentage of total oxygen consumption of sperm suspension and could not be accurately estimated from measurements of the buffered semen samples.

P22. The Breeding Efficiency of Dairy Bulls Used Both Artifically and Naturally.* E. R. Berousek, Dept. of Dairy Husbandry, Univ. Mo., Columbia, Mo.

A survey of the literature concerning the artificial breeding of over 10,000 dairy cows indicates that approximately 1.7 services per conception were required as compared to approximately 2.2 services per conception for approximately the same number of cows in various herds where natural breeding was practiced. The records concerning artificial breeding cover only the past four years, whereas those for natural breeding are taken from reports dating back as early as 1900. In order to compare natural vs. artificial breeding efficiency, half the Missouri Station dairy herd was bred naturally and the other half artificially for a 2-year period (1937–1939). During this period artificial breeding required 1.59 services and natural breeding 1.66 services per conception.

The study reported herein includes 14 bulls used both artificially and naturally—8 Holsteins, 5 Jerseys, and 1 Guernsey. Only records of cows or heifers which have proved to be fertile are included in this summary. A

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station Journal Series No. 841.

few animals suffering genital abnormalities, and failing to conceive irrespective of the sire or breeding method used, have been eliminated from the averages.

The eight Holstein bulls settled 209 cows with 347 natural services with an average of 1.66 services per conception. Semen from the same bulls used to inseminate 127 cows resulted in 67 pregnancies or 1.89 services per conception. The average service rate per bull ranged from 1.33 to 2.02 for natural breeding and from 1.00 to 5.00 artificially. One bull was used 146 times naturally and settled 90 cows with an average service rate of 1.62. The same used 67 times artificially settled 34 cows with an average of 1.97 services per conception. Another bull used only four times naturally settled three cows. Semen from the same bull was used to inseminate five cows and all five of them conceived. One young bull was used 9 times artificially and all 9 cows were settled. He was never used naturally and is not included in this report.

One hundred and fifty-one cows were bred naturally by the five Jersey bulls and 95 of them conceived for an average of 1.59 services per conception. One hundred and six cows were artificially inseminated with semen from these bulls and 49 settled, requiring 2.16 services per conception. The service rate per conception ranged from 1.38 to 4.66 for naturally bred and 1.32 to 4.25 artificially.

The Guernsey bull served 49 cows with 31 pregnancies resulting, or 1.58 services per conception. Twenty cows bred artificially, of which 12 conceived, required 1.67 services per conception.

The 14 bulls had a total of 547 services with 335 conceptions when used naturally and 253 inseminations with 128 conceptions when used artificially. The average number of services per conception was 1.63 and 1.98, respectively. There were many variations per individual service rate. Four bulls had a lower service rate per conception when used artificially than when used naturally as compared to nine bulls whose lowest service rates were obtained when used naturally. One bull had the same service rate per conception for each method.

The lower efficiency of artificial breeding is not considered significant because in many cases semen stored for 24 to 72 hours was used. A few of the bulls used in the herd in recent years were old proved sires low in fertility and during this time most of the breeding has been done by artificial means. All factors considered, it is concluded that there is little difference in the service rate of natural and artificial breeding.

P23. A Comparison of Artificial vs. Natural Service in Heifers When Bred to the Same Sire. C. E. SHUART, O. L. LEPARD, AND J. W. BARTLETT, N. J. Agr. Expt. Sta., New Brunswick, N. J.

Forty-four virgin Holstein and Guernsey heifers were alternately

selected within each breed for artificial or natural service as they reached 18 months of age. Only heifers which had previously shown normal oestrus cycles were selected.

The sires were virgin Holstein and Guernsey bulls. All heifers were served naturally or artificially to these bulls according to their grouping and breed. The breeding was limited to one service or one ejaculate unless four or more days had elapsed since a sire had been used. In this case two services were allowed or two ejaculates collected. If more than one animal was bred naturally to the same sire on the same day, six hours elapsed between services. Likewise if one animal was bred naturally and another artificially inseminated, six hours elapsed between the service and collection. All inseminations were made immediately after collection and examination with undiluted semen. Examinations for pregnancies were made at approximately sixty days after the last service.

The study shows a significant difference in conception rate between the two groups. The 22 animals artificially inseminated required 24 services, giving a conception rate of 1.06 (services per conception) with 90.6 per cent conceiving on first service. The 22 heifers bred naturally required 37 services, giving a conception rate of 1.67 (services per conception) with 63.6 per cent conceiving on first service.

P24. The Availability of Carotene in Alfalfa Hay as Compared with Carotene in Oil. J. H. Hilton, J. W. Wilbur, R. J. Westfall, and S. M. Hauge, Purdue Univ., Lafayette, Ind.

Two groups of two Guernsey cows each were used in feeding trials to determine the relative availability of carotene in dehydrated alfalfa hay as compared with carotene dissolved in oil. The body stores of vitamin A in the cows were depleted in a preliminary feeding period by feeding a vitamin A deficient ration. In successive feeding periods, the carotene of the hay and the carotene in the oil were equilibrated at levels of 130, 200, 300 and 200 milligrams daily during the respective feeding periods.

Biological assays of the milk fat secreted by the two groups of cows on the respective rations indicate that dairy cows can utilize carotene in plant tissues as readily as isolated carotene.

P25. The Cause of the Initiation of Lactation at Parturition.* Joseph Meites and C. W. Turner, Dept. Dairy Husbandry, Univ. Mo., Columbia, Mo.

In most animals the mammary glands reach a full state of development during pregnancy, but usually there is little or no milk secretion until after parturition. The study of the lactogenic hormone in the pituitary of

* Contribution from the Department of Dairy Husbandry, Missouri State Agricultural Experiment Station Journal Series No. 837.

numerous animals during pregnancy and lactation has consistently revealed that the lactogen content of the pituitary remains relatively low during pregnancy, but increases sharply following parturition. The conclusions were drawn, therefore, that (1) the lactogen content of the pituitary was intimately associated with mammary secretion; (2) the low lactogen content of the pituitary during pregnancy probably accounted for the relative absence of milk secretion during this period; and (3) at parturition, some activating factor was responsible for the increase in the lactogen content of the pituitary and the consequent onset of lactation.

Experimentally, the administration of estrogen has been found to greatly increase the lactogen content of and secretion by the pituitary, and also to initiate milk secretion in suitably prepared mammary glands. Small or moderate amounts of estrogen were shown to be more effective in these respects than large dosages of hormone. By administering estrogen for only 5 days into mature female rats or into immature guinea pigs of either sex, it was found possible to increase the lactogen content of the pituitary by more than 200 and 400 per cent, respectively, or to levels higher than or equal to the amount of lactogen present in the pituitaries of these animals after parturition.

During the course of pregnancy, despite the greatly increased amounts of estrogen which are known to be present, there is little or no increase in the lactogen content of the pituitary. Apparently, some factor overrides the stimulating effect of estrogen on the pituitary during this period. This is not entirely unexpected, however, since other physiologic effects of estrogen are also overriden during pregnancy. Thus, (1) estrus is suppressed, (2) ovulation is inhibited, and (3) the uterine musculature remains relatively quiescent. There is good reason to believe that it is progesterone which overrides all these normal physiologic effects of estrogen during pregnancy. Thus, if the corpora lutea are removed during advanced pregnancy in some animals, the fetus or fetuses are expelled, ovulation and estrus set in, and milk secretion is initiated. On the other hand, if the corpora lutea are maintained, or if progesterone is administered, pregnancy can be prolonged beyond the normal span of time.

It is the belief of the writers, therefore, that during pregnancy, progesterone overrides the stimulating effect of estrogen on the lactogenic hormone of the pituitary, but at parturition with the removal of progesterone from the organism, estrogen is able to instigate a rapid increase in the lactogen content of the pituitary and thus initiate lactation. The experimental basis for this theory will be presented.

On the basis of this theory, it appears probable that moderate doses of estrogen administered after parturition may prove beneficial in cases of hypogalactia in animals, provided that such abnormalities are caused by a deficiency of lactogenic hormone.

P26. Prehypophyseal Hormone (Mammogen) Control of Mammary Development.* E. T. GOMEZ, Division of Nutrition and Physiology, Bureau of Dairy Industry, U.S.D.A., Washington, D. C.

Stimulation of growth of the duct system of the mammary glands of hypophysectomized-castrated guinea pigs has been induced either by implanting (2 cases) or injecting (8 cases) 20 to 50 mg. of fresh prehypophyseal gland tissue from male or female guinea pigs. The material was injected in saline suspension, the dose being apportioned over a period of 10 days. The total material obtained by extracting the same amount of fresh prehypophyseal gland tissue with a warm mixture of absolute ethyl alcohol (8 parts) and ether (U.S.P., 2 parts) was injected, similarly apportioned, in 10 daily administrations. This resulted in growth of the mammary glands, equaling that of early pregnancy, in hypophysectomized-castrated guinea pigs of either sex (10 cases). The extract showed no histological evidence of reparative effect upon the atrophied thyroid and adrenals of the test animals; there was no body growth-promoting effect; and, in the females, cornification of the vaginal epithelium was not manifest.

Administered in dosages equivalent to 5 times (100 mg.) the above minimum effective dose level of fresh prehypophyseal glands (20 mg.), the alcohol-ether extracted glands showed no mammary gland growth-promoting activity (mammogenic) in hypophysectomized-castrated guinea pigs (4 cases).

Ten mg. of an impure preparation which contained the lactogenic hormone, when administered daily for 10 to 15 days, either alone (2 cases) or in combination with 75 I.U. of estrone (2 cases) or with 5 mg. of progesterone (2 cases) or 5 mg. of desoxycorticosterone (2 cases), did not cause growth of the mammary glands of hypophysectomized-castrated male or female guinea pigs.

More recently, it has been found that the daily administration of 25 mg. of the lactogenic hormone alone for 10 days causes a slight growth stimulation of the duct system of the mammary glands of hypophysectomized-castrated guinea pigs. The duct growth response was improved when 75 I.U. of estrone was administered daily in addition to the lactogenic hormone treatments (2 cases).

The response noted above with 25 mg. was not obtained, either with or without estrogen, when the lactogenic hormone was pre-treated with warm alcohol-ether mixture (2 cases) although the preparation still possessed lactogenic activity. The original as well as the alcohol-ether treated lactogenic hormone preparation was found to have, in addition to its lactogenic property, appreciable thyrotrophic, gonadotrophic, and adrenotrophic activities.

* This research was supported by an appropriation from Bankhead-Jones funds (Bankhead-Jones Act of June 29, 1935).

The animals used in the above experiments were hypophysectomized and castrated at 6 weeks of age, when they weighed from 150 to 200 g. The treatments with all these operated animals were started 60 to 100 days after hypophysectomy. The mammary gland growth was determined by study of the whole mounts of stained and dissected glands.

P27. The Effect of Adrenalectomy on the Lactogenic Hormone and Initiation on Lactation.* J. L. TRENTIN, J. MEITES, AND C. W. TURNER, Dept. of Dairy Husbandry, Univ. Mo., Columbia, Mo.

It has become well established that the adrenals are essential for normal lactation. It has not yet been adequately determined, however, whether the injurious effects of adrenalectomy upon lactation are due entirely to the abnormalities which are known to arise in salt, water, and carbohydrate metabolism, or also because of detrimental effects on the lactogenic function of the pituitary. It was to shed some light on this second possibility that the present investigation was undertaken.

Evidence has been presented elsewhere showing that (a) experimentally, estrogen can increase the lactogenic potency of the pituitary and initiate lactation, and (b) that estrogen is probably the active agent responsible for the natural increase in pituitary lactogen and initiation of lactation at parturition. Answers were sought, therefore, to the following questions: (1) What is the effect of adrenalectomy on the normal lactogen content of the pituitary? (2) Does adrenalectomy affect the ability of estrogen to augment the lactogen content of the pituitary? (3) Can adrenalectomy during pregnancy prevent the normal rise in pituitary lactogen and initiation of lactation which occur at parturition?

The following results were obtained. Fifteen normal female albino rats contained an average of 5.05 Reece-Turner Units of lactogenic hormone per pituitary, while two groups of adrenalectomized rats (total of 33) contained an average of 3.91 and 3.75 R-T.U. of lactogen, respectively. This significant reduction in pituitary lactogen following adrenalectomy may be due to (a) a direct effect on the pituitary, (b) suspension of the estrus cycle, or (c) reduction in food intake.

The administration of 1000 I.U. of estrone into 10 intact female rats increased the average lactogen content of the pituitary to 15.75 R-T.U., or about 212 per cent, while the same amount of estrone injected into 14 adrenalectomized rats increased the average lactogen content of the pituitary to only 10.87 R-T.U., or about 115 per cent. Although the results obtained on adrenalectomized guinea pigs were less conclusive, the available data indicate that estrogen injected into such animals elicits the same increase in pituitary lactogen as in intact guinea pigs.

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station Journal Series No. 836.

Albino and white hooded rats which were adrenalectomized during the last week of pregnancy showed the same increase in pituitary lactogen 48 hours after parturition as did intact parturient rats. Milk was present in the mammary glands of the adrenalectomized mother rats and also in the stomachs of their living young, but not in amounts equaling that found in intact rats. It is concluded, therefore, that the failure of rats adrenalectomized during pregnancy to lactate sufficiently following parturition is not due to a deficiency of lactogenic hormone in the pituitary. This conclusion is supported by the fact that lactation cannot be initiated or maintained in adrenalectomized animals by administering lactogenic hormone.

P28. The Influence of Thyroxine upon the Stimulation of Mammary Lobule-Alveolar Growth.* JOHN P. MIXNER, Dept. of Dairy Husbandry, Univ. Mo., Columbia, Mo.

Ovariectomized virgin female mice were used as assay animals in a study to determine the influence of thyroxine upon the stimulation of mammary lobule-alveolar growth by progesterone and estrone. The criterion of response was the percentage of mice showing positive mammary lobule-alveolar responses after 10 daily subcutaneous injections of the test substances.

Thyroxine at an optimal level increased significantly the percentage of mice which responded with mammary lobule-alveolar growth to minimal doses of progesterone and estrone. There was an increase of 25 per cent in the efficiency of progesterone and estrone in causing such growth.

Thyroidectomy inhibited the ability of the mice to respond to progesterone and estrone with mammary lobule-alveolar growth.

These observations are taken to indicate that the injection of thyroxine or the feeding of thyroprotein during pregnancy might cause greater stimulation of the mammary lobule-alveolar system and thus the potential capacity for milk secretion in subsequent lactation periods. This is in addition to the already recognized stimulating effects of these substances upon the secretion of milk and milk fat during lactation.

P29. The Effect of Thyroxine on Rate of Growth and Efficiency of Weight Increment.† MARVIN KOGER AND C. W. TURNER, Dept. of Dairy Husbandry, Univ. Mo., Columbia, Mo.

Immature virgin female mice were given subcutaneous injections of crystalline thyroxine in dosages varying from 0.015 mg. to 0.04 mg. daily. During an experimental period of 5 weeks, the thyroxine treated mice gained 38 per cent more weight and consumed 25 per cent more feed than suitable

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station Journal Series No. 840.

† Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station Journal Series No. 834.

controls. The treated animals also stored more nitrogen, while the controls retained more fat.

The thyroxine injected animals gained more in body weight and stored more nitrogen per unit of feed intake than did the controls. This increased mobilization of nitrogen is of particular interest since it may partially explain the mechanism whereby thyroxine treatment increases milk production and rate of growth of animals.

Similarly, the artificial thyroprotein (thyrolactin) was fed and injected into comparable groups of mice for similar periods of time. The growth rate of the experimental animals in both cases exceeded the normal controls.

It is suggested that other animals may respond to proper thyroxine treatment in a manner similar to mice.

P30. Growth and Energy Metabolism of Thyroidectomized Cattle.* SAMUEL BRODY, Dept. of Dairy Husbandry, Univ. Mo., Columbia, Mo.

The manner in which size and energy metabolism change with age in a thyroidectomized Jersey heifer in contrast to that of a normal control will be illustrated with slides and the practical implications noted. Removing the thyroids at 54 days of age led to reduction in mature body weight by 50 per cent and heat production (metabolism) per square meter by nearly 40 per cent. The animal was completely undeveloped sexually at 3½ years of age. The administration of Reineke's and Turner's "thyrolactin" for three months brought on the first heat period.

P31. The Effect of Thyrolactin on Milk Production, Metabolism, and Growth.† E. P. REINEKE, Dept. of Dairy Husbandry, Univ. Mo., Columbia, Mo.

Data are presented to show the physiologic effects elicited by the administration of thyrolactin, a preparation of iodinated casein prepared under such conditions as to yield a compound with high thyroidal activity. When administered to tadpoles, either orally or parenterally, thyrolactin stimulates precocious metamorphosis. The percentage decrease in body length of tadpoles is proportional to the logarithm of the thyrolactin dosage. The percentage increase in oxygen consumption of normal partially-fasted guinea pigs in response to graded doses of thyroxine, given orally, also varies with the logarithm of the dosage. Typical preparations of thyrolactin produce 1 per cent of the response of an equivalent weight of thyroxine when given orally to guinea pigs and 2.7 per cent of the thyroxine response when injected intraperitoneally into frog tadpoles.

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station Journal Series No. 832.

† Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station Journal Series No. 839.

Photographs and growth curves are presented to show the effectiveness of thyrolactin in supporting growth and alleviating the symptoms of cretinism of young female goats that were thyroidectomized shortly after birth. Beginning with a dosage of 0.5 gm. daily, the thyrolactin was gradually increased, reaching 2 gm. daily after approximately one year. All animals so treated grew steadily and retained a normal body confirmation. Administration of thyrolactin to an animal in advanced stages of cretinism resulted in rapid improvement. Fed to a three-year-old thyroidectomized Jersey heifer in amounts of 3 to 20 gm. daily, depending upon the potency of the material used, thyrolactin stimulated increases in metabolism of 20 to 30 per cent. The increased metabolism was accompanied by an improvement in appearance and vigor and the initiation of normal estrus cycles. Increases were noted in the milk yield, milk fat percentage and yield of butterfat of lactating cows after feeding thyrolactin for a three-day period.

P32. The Chemical Formation of Highly Active Thyroprotein.* E. P. REINEKE, Dept. of Dairy Husbandry, Univ. Mo., Columbia, Mo.

It is demonstrated that the extent of formation of thyroidal substance during and subsequent to the iodination of proteins depends upon the conditions of the reaction. When the iodination is conducted in a medium buffered with sodium bicarbonate, thyroidal activity does not attain the maximum until sufficient bicarbonate has been added to maintain the pH within the range of 6.8 to 8.0. With the concentration of bicarbonate held within the optimal range, the iodine concentration becomes a controlling factor in the formation of thyroidal substance. When the iodine concentration is increased progressively in successive preparations, the thyroidal activity of the resulting product reaches a maximum when sufficient iodine has been combined to substitute two atoms per mole of tyrosine in the protein. Further iodination leads to significant losses in activity. When the concentration of both the iodine and bicarbonate is held constant at the optimal levels, further significant increases in thyroidal activity are obtained by proper control of the iodination and incubation temperature. If both the iodination and incubation are conducted at 38° to 40° C., the reaction involved in the formation of the thyroidal substance soon comes to equilibrium, and no further increase in activity occurs no matter how long the incubation period is extended. The resulting products produce one per cent of the response of thyroxine when assayed orally on guinea pigs or 2.7 of the thyroxine response when injected into frog tadpoles. A pronounced increase in thyroidal activity can be obtained by elevation of the temperature to 60° C. or above either during or subsequent to iodination. The reaction is apparently catalyzed by a metal or combination of metals contained in

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station Journal Series No. 838.

brass. With the concentration of iodine and bicarbonate at the optimal level, the incubation temperature at 65° to 70° C. and in the presence of a brass stirrer, the thyroidal activity of the resulting product is four per cent of that of thyroxine as assayed orally on guinea pigs or 10.6 per cent as measured by injection into tadpoles. When compared on an equal iodine basis, the effect on tadpoles is equivalent to that of synthetic thyroxine. Crystalline thyroxine has been recovered from a barium hydroxide hydrolysate of iodinated casein, and its identity has been established by its microscopic structure, iodine content, melting point, spectrographic absorption, and tadpole assay.

P33. Methods for Prolactin Assay Including Data on the Anterior Pituitary Prolactin Content of Dairy and Beef Cattle and Female Rabbits in Several Physiological Conditions.* S. R. HALL AND B. H. NICOLET, Division of Nutrition and Physiology, Bureau of Dairy Industry, U.S.D.A., Washington, D. C.

Two methods of assay with pigeons—the systemic crop-sac weight and the intradermal local—were studied. With the systemic method, using exclusively 6-week-old, white Carneau pigeons, a more than 2-fold variation in response, over a 1-year period, was noted on groups of 10 or more birds receiving the same amount of the same material (confirming Bates and Riddle). The dose-response relationship of Riddle and Bates was confirmed only for crop-sac stimulation above approximately 2,300 mg. Below this level of response, the slope of the regression line is not as steep as that proposed by the above authors. The influence on the response of route of administration, volume of solution injected, and sex of the birds, was also considered.

By the method of comparing, in the same bird, one crop-sac with the other, after a 4-day intradermal local injection period (method of Reece and Turner) the dose-response curve for extracts and suspensions of anterior pituitary tissue, International Standard prolactin, and purified prolactin, was investigated. It was found by this method that the volume of solution injected, the position of the local injection with respect to succeeding injections, and the presence of muscle extract in purified prolactin solution, were all factors in the response.

Also with this method, acetone dried anterior pituitary powder when administered as a suspension was found to give about the same response as one-fifth as much of the same material injected as an extract. Two samples of bovine anterior pituitary material, one of which was found to be about twice as potent as the other for prolactin by the systemic method, were not distinguishable when tested as suspensions. Yet doubling or halving the amount of a suspension did lead to a noticeable difference in response.

* This research was supported by an appropriation from Bankhead-Jones funds (Bankhead-Jones Act of June 29, 1935).

The amount of variation in response to the same dosage in a group of birds of the same age and breed was very great. This held for minimum responses as well as for greater. However, under the proper conditions, comparison of the two crop-sacs of the same bird at several levels of response was regarded as satisfactory.

A few assays by the systemic weight method on dairy animals with known history did not indicate more pituitary-contained prolactin than from prime beef steers. Inadequacy of material for an acceptable comparison between dairy and beef cattle necessitated the use of slaughterhouse material. Bulls, cows, and heifers were compared. Assay data from this material by the systemic method on pigeons of the same shipment, as well as assays of extracts by the intradermal local method, does not confirm Reece and Turner in their conclusion that there is more prolactin in the anterior pituitary from dairy breeds of cattle than from comparable beef breeds. Reece and Turner used suspensions of acetone-dried material.

The 2 methods both showed that the sexually mature virgin female contained less prolactin than did the 20-day-pregnant animal. The latter contained about as much as the 8-day-postpartum suckled doe. Pseudopregnant, pseudopregnant spontaneously lactating, and 20-day-pregnant does all contained about the same amount of prolactin. It was also found that the stimulus from suckling brought about perhaps more of a decrease in pituitary prolactin content than was found by Holst and Turner. It is to be noted that we find about five times as much prolactin in the pituitaries of rabbits and cattle in comparison with the International Standard as do the Missouri workers. The approximately 80 per cent of the prolactin not accounted for in their assays, due to the use of suspensions, probably explains most of the differences between their results and ours. The use of the two crop-sacs of the same bird for comparison, as first proposed by Reece and Turner, and which the Missouri group has not always followed, would also probably lead to better agreement with our results.

P34. An Intravenously Active Ovulating Factor in the Juice of Corn and Oat Plants.* J. T. Bradbury and R. E. Hodgson, Division of Nutrition and Physiology, Bureau of Dairy Industry, U.S.D.A., Washington, D. C.

The investigation of the nature of the rabbit-ovulating factor which, as described by Friedman (1934), occurs in plant juices and is active when injected intravenously into the rabbit, has been continued. This active material can be precipitated from plant juices either by means of benzoic acid or by the addition of sulphuric acid to pH 4. Aqueous solutions (pH 7.4) of these acid precipitates are frequently very toxic and may produce

* This research was supported by an appropriation from Bankhead-Jones funds (Bankhead-Jones Act of June 29, 1935).

symptoms suggestive of snuffles within a few hours after intravenous administration to a rabbit. Repeated precipitations of the aqueous extracts at pH 4 followed by desiccation with acetone, reduces the toxicity to such an extent that ovulation may be induced with extracts that were lethal initially. Temperatures as high as 85° C. do not destroy the active material in plant juice but are helpful in reducing the toxicity of the extracts.

Corn and oats grown in the greenhouse during the winter months have not yielded active extracts. The variation in potency of field-grown plants has been great (10 to 125 ovulating doses per liter of juice) but these fluctuations have not been correlated either with the stage of development of the plant or the season of the year. Samples of juice were sealed into tinned cans and stored in the freezing room. Preparation of extracts and testing of these frozen juices at frequent intervals have demonstrated that frozen juice will retain its potency for at least 22 months. Furthermore it has been shown that in the late summer and fall there is such a marked decrease in the sensitivity of the rabbit that negative tests were obtained from August to November with doses of extract that gave positive tests in early summer and then again from January to May.

The seasonal variation in the sensitivity of the rabbit is such that a different test animal would be desirable. Preliminary experiments have shown that intravenous or intraperitoneal injection of these plant extracts will induce pseudopregnancy in the adult estrous rat. The usual gonadotrophic hormone assay method of subcutaneous injection into the immature female rat has given negative results in doses that varied from one half to 4 times the effective dose in the rabbit. Feeding of these preparations has not given any indication of being active orally. Further chemical purification and studies on the physiological action of this substance will be necessary before any suggestion can be made for its practical use.

P35. Further Evidence of the Existence and Specificity of an Orally Active Sex Maturity Factor(s) in Plant Juice Preparations.*

E. T. Gomez, Div. of Nutrition and Physiology, Bureau of Dairy Industry, Washington, D. C.

The presence of a factor(s) in the juice of the young oat plant that is capable of inducing precocious puberty when administered *per os* to immature rats was reported last year (36th Annual Meeting Amer. Dairy Sci. Assoc. June 1941). The study of this material has been continued. Preparations obtained from the juice of freshly cut young oat and corn plants, that were collected during the growing season of 1941, as well as from the juice of oat plants that were collected in 1940 and frozen and stored for as long as 574 days in a refrigerating room maintained at −10° C., have brought

* This research was supported by an appropriation from Bankhead-Jones funds (Bankhead-Jones Act of June 29, 1935).

about vaginal patency (precocious puberty) in rats at 27 to 32 days of age when fed to them beginning at 21 to 22 days of age. In the following report, this plant material will be referred to as SMF (sex maturity factor).

Sixteen 21- to 22-day-old rats were fed an SMF preparation from oat or corn juices in amounts each totaling from 200 to 2,000 mg. during the experiment. Fourteen of these rats, which received from 325 to 2,000 mg. of SMF, showed vaginal patency when 27 to 32 days of age. Autopsy of these rats 24 to 48 hours after vaginal patency occurred revealed ovaries weighing from 19 to 31.0 mg. and uteri from 53.0 to 125.0 mg. A like number of litter mate control rats, autopsied simultaneously had ovaries weighing from 15.0 to 18.0 mg., and uteri weighing from 35.0 to 42.0 mg. Gross and histological examinations of reproductive organs revealed varying degrees of development of the follicles or corpora lutea, or both, in the ovaries and there was evident hyperplasia of the endometria. The vaginas of the 2 remaining rats, which received a total of 200 mg. of the preparation of SMF, were closed when autopsied at 32 days of age. The weights of their ovaries and uteri were within the range of those of the controls.

The feeding to each rat of a total of 1,200 μ gm. of vitamin E (alpha-tocopherol) or 400 mg. of vitamin C (Cevitamic Acid, Merck), or 350 mg. of glutathione or of 1,000 mg. of desiccated anterior pituitary tissue of cattle in addition to the basal diet, did not bring about the early vaginal patency of immature rats.

Female pups (foster or otherwise), nursed by a mother fed a potent SMF preparation, beginning at 1 week before or immediately after parturition, showed vaginal patency when 10 to 14 days of age. Autopsy of these pups (9 cases), 24 hours after vaginal patency, revealed ovaries weighing from 7.0 to 10.0 mg., and uteri from 21.0 to 29.0 mg. A like number of control pups (nursed by stock mothers), autopsied simultaneously, had ovaries weighing from 2.0 to 4.0 mg., and uteri from 8.0 to 17.0 mg.

Male pups (7 cases) nursed by SMF fed mothers were autopsied when 15 days of age. The average weight of the gonads was 76.0 mg.; the combined weights of the prostate and seminal vesicles, 25.0 mg.; and seminal vesicles alone, 9.0 mg. The corresponding weights for control pups of the same age were 42.0, 11,8, and 3.4 mg., respectively.

P36. Some Possibilities for the Use of Diethylstilbestrol in Dairy Cattle.*

A. A. Lewis, Dept. of Dairy Husbandry, Univ. Mo., Columbia, Mo.

Diethylstilbestrol has been shown to cause copious and prolonged milk secretion in virgin and dry dairy animals following injection, percutaneous application to the udder, subcutaneously implanted pellets, or oral administration.

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Diethylstilbestrol is being used commonly by doctors to relieve the edema, caking, and inflammation of breasts at parturition. Similarly, diethylstilbestrol may be found useful in dairy cattle at this time when the udder is caked, swollen and painful.

There are a number of reports that the use of estrogens is beneficial in some cases of sterility in cattle. Diethylstilbestrol, being a very active estrogen, and cheap, may have some promise in this condition.

Another possibility for the use of diethylstilbestrol in dairy cattle is after abortion in the last half of pregnancy. The mammary glands are prepared for the next lactation by the sixth month of pregnancy. During the last three months what occurs in heifer udders is mostly the beginning of secretion and a swelling of the udder with the accumulation of secretion. Then at calving there is a surge of milk production, due, according to present evidence, to the action of estrogenic hormone in increasing the production of lactogen from the anterior pituitary. In abortion this increase in lactogen may be missing because estrogen has not acted on the pituitary gland. If estrogen is supplied by the injection of diethylstilbestrol it should improve the milk production from such cows.

The possibilities for use of diethylstilbestrol in dairy cattle are great because of its cheapness and great activity. It may be found useful in bringing into production sterile cows which would otherwise be lost to the herd. It may prove beneficial on caked udders at calving, in some cases of sterility, and after abortion. In addition, there are probably other untried possibilities for the use of diethylstilbestrol in dairy cattle. Experimental exploration of these possibilities is indicated.

P37. The Influence of Ascorbic Acid on the Gonadotropic Hormone Content of the Male Rat Pituitary Gland.* R. P. Reece and E. J. Weatherby, N. J. Agr. Expt. Sta., New Brunswick, N. J.

Evidence from several laboratories suggests that ascorbic acid may have an influence on reproductive processes. Because of the established role of gonadotropic hormones in reproduction it was thought worthwhile to determine the effect of ascorbic acid on pituitary gonadotropic hormone content.

Thirty sexually mature male rats were paired on the basis of body weight and age and one of each pair was injected subcutaneously daily for fifteen days with 15 mg. of ascorbic acid. The day after the last injection all of the rats were killed and their pituitary glands weighed. The gonadotropic hormone content of the pituitary glands was estimated by injecting a suspension of each pituitary in eight divided doses over a four-day period into a 24-to-26-day-old rat. The recipients were killed 100 hours after the first injection and the ovaries were weighed.

* Journal Series Paper of the New Jersey Agricultural Experiment Station, Rutgers University, Department of Dairy Husbandry.

The mean differences of the individual comparisons of the ovarian weights were not significant, thus indicating that the ascorbic acid treatment had no influence on pituitary gonadotropic hormone content.

P38. Vitamin D, the Parathyroid Glands, and Calcium Metabolism.* I. L. CAMPBELL, Dept. Dairy Husbandry, Univ. Mo., Columbia, Mo.

The parathyroid gland is normally the key regulator of calcium metabolism within the animal body. Its varying activity equates the supply of calcium to the demand for calcium—supply being represented by food calcium absorbed together with mobilizable reserve bone calcium, and demand by the calcium required by the animal for growth, maintenance, and production.

Lactation entails a greatly increased demand for calcium. Data are presented which show that the parathyroids of lactating rabbits are greatly increased in weight over those of normal females, even though these animals are fed good quality alfalfa hay ad lib. and a grain mixture containing one per cent bone meal. This hypertrophy is related to the amount of milk secreted, for when the number of young suckling is reduced to two, there is little increase in parathyroid weight. Heavy lactation involves an increased parathyroid activity.

If the diet is low in calcium, increased parathyroid activity is required for the mobilization of reserve bone calcium. Data are given for normal rabbits and rats to illustrate this point.

Vitamin D promotes the absorption and utilization of calcium. Rats subsisting over several months on a diet low in calcium and in Vitamin D have greatly enlarged parathyroid glands, but if the same ration has Vitamin D added, the glands are found to be significantly smaller, although still somewhat above normal size. Thus a sufficient supply of this vitamin tends to have a parathyroid-sparing action.

P39. Oxygen Uptake and CO_2 Elimination of the Bovine Mammary Gland. W. E. PETERSEN AND J. C. SHAW, Univ. Minn., St. Paul, Minn.

The oxygen uptake and CO_2 elimination were determined from 157 pairs of simultaneously drawn arterial and venous blood samples from both intact cows and perfusion experiments on active and inactive glands. The average oxygen uptake by the lactating gland of intact cows was 4.78 volumes per cent with 5.59 volumes per cent CO_2 elimination. For perfused active glands the average values for O_2 and CO_2 were 7.52 and 7.37, respectively. For intact dry glands the O_2 uptake and CO_2 elimination was 5.28 and 3.02 while the corresponding values for the perfused dry glands were 6.79 and 7.32.

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station Journal Series No. 835.

The average respiratory quotients were: 1.20 for intact lactating; 1.05 for perfused lactating; 0.76 for intact dry; and 1.11 for perfused dry glands. The striking feature about the data is the great variation in O_2 uptake, CO_2 elimination and respiratory quotients. The oxygen uptake for the lactating intact gland varied from 2.7 to 7.0 volumes per cent while the CO_2 elimination in this group varied from 1.51 to 9.27 volumes per cent and the R. Q. from D.625 to 2.26. The variability for intact dry glands was of the same magnitude as was also the case with the perfusion experiments.

No correlation between the glucose uptake and O_2 uptake or CO_2 elimination was found. Nor were there any correlations between the time interval after milking and the drawing of the blood samples. It was also noted that the variations in O_2 consumption and CO_2 elimination were as great in the experiments where there were no blood volume changes as in the cases where there were marked changes in blood volume.

P40. The Enzymatic Hydrolysis of Diacetin by Bovine Mammary Gland Tissue. PHILIP L. KELLY, Ark. Agr. Expt. Sta.

Previous work on this project has indicated an active lipase was present in bovine mammary gland tissue which acted on such substrates as tributyrin, tripalmitin, trilaurin, and ethyl-oleate. While the activity per gram of tissue is not large, the total hydrolysis on the basis of total weight of secretory tissue in the gland would be quite a significant factor to consider in milk fat synthesis.

In the work to be reported in this paper a substrate of smaller molecular weight, diacetin (glycerol diacetate) was used. With tissue previously prepared by drying with acetone and ether there was a great deal more enzymatic activity with this substrate than a comparison with the substrates previously used would indicate. While diacetin as such is not an important compound in milk secretion, the fact that it is acted on so readily by tissue enzymes would indicate that similar compounds which are important in this process might be similarly affected.

P41. The Effect of the Continuous Injection of Pitocin upon Milk and Milk Fat Production. C. B. KNODT AND W. E. PETERSEN, Univ. Minn., St. Paul, Minn.

The injection of the oxytocic principle of the posterior lobe of the pituitary in the form of pitocin has been studied in relation to the ejection of milk in the mammary glands of the bovine. In this experiment an attempt was made to observe the effect of the injection of pitocin following each normal milking upon total milk and milk fat production as well as the percentage of milk fat.

Four cows were utilized in a double reversal type of experiment during a six week period. Two cows were injected following the regular milking

and then the "Pitocin Milk" was removed during the first and third fourteen day periods while the other two cows were injected only during the second fourteen day period with the first and third fourteen day periods serving as controls. One milliliter of pitocin (10 units) was used as the standard quantity for all injections. The injections were made intrajugularly immediately after the normal milking and the "Pitocin Milk" removed thereafter.

These cows were in the late stages of lactation and a significantly higher total milk production was noted during the periods of injection as compared to the control periods of non-injection. Three of the cows showed an increase in the percentage of milk fat in the total milk produced during the period of injection while the results on the fourth cow were not as conclusive.

A marked decrease was observed in total milk and milk fat production following the periods of injection. In all but one of the cows there was an increase in the proportion of "Pitocin Milk" with a concomitant decrease in normal milk production as the period of injection progressed. This observed decrease in normal milk may be due to the large amount of pitocin injected and while a smaller amount may produce a similar increase in total production the amount of normal milk might conceivably be increased or at least not so significantly decreased.

It would appear from these experiments that both the amount of milk and milk fat produced may be dependent upon the completeness of the evacuation of the elveoli at the time of milking and that the failure of the cow to completely let down her milk may account for a rapid decline in milk production with the advance of lactation.

P42. The Incidence and Control of Milk Fever. C. F. Monroe, W. E. Krauss, T. S. Sutton, and W. D. Pounden, Dairy Dept., Ohio Expt. Sta., Wooster, Ohio.

The importance of preventing milk fever was impressed upon us in the maintenance of a herd of mature Jersey cows used in pasture investigations. These cows were bred so that they would calve in late winter and early spring, seasons of the year when the incidence of milk fever is high.

In order to study the effect of the feeding program, the normal dry cow ration of corn, oats, wheat bran, minerals and salt was compared with one containing so-called conditioning feeds composed of oats, wheat bran, linseed oil meal, beet pulp, molasses, minerals and salt. These grain mixtures were compared in two different years, so that all the cows received both mixtures. Out of 34 freshenings, there were 7 cases of milk fever, of which 4 were on the conditioning ration containing molasses. Although these data are too limited for definite conclusions, they do show that milk fever can occur even when the so-called conditioning feeds are used.

Following this, irradiated yeast has been tried, since some work reported

by Sjollema indicated favorable results in preventing milk fever by fortifying the ration with vitamin D, dry irradiated yeast in amounts to furnish approximately one million units of vitamin D daily to each cow has been fed for a period of 30 days previous to and one week following freshening. For a control, comparable cows have received the same general care and feedings but without the supplementary yeast. The investigation has been extended to not only include the Pasture Farm Herd, but also the main Experiment Station Herd and that of the Ohio State University.

The data on this work accumulated to this time consist of 75 freshenings of Ayrshire, Guernsey, Holstein and Jersey cows, first parturitions not being included.

The weight of the evidence indicates that the feeding of irradiated yeast reduced the incidence of milk fever. Although there have been cases of milk fever when the yeast was fed, in some of these at least there existed complicating conditions which have nullified a possible benefit from the supplement. On the other hand, a "qualitative" analysis of the data from those cows known to be subject to this trouble suggests that the yeast feeding may have been of some benefit.

In twenty-six freshenings of the milk fever "addicts" the incidence of milk fever was 73 per cent when no yeast was fed and 20 per cent when yeast was fed. The later percentage would be materially reduced if those cases where known complications existed were omitted in the calculations.

P43. The Blood Picture in Normal and Milk Fever Cows. W. E. KRAUSS, C. F. MONROE, R. G. WASHBURN, J. W. HIBBS, T. S. SUTTON AND N. VAN DEMARK, Dairy Dept., Ohio Expt. Sta., Wooster, Ohio.

In a preliminary trial with a small herd of Jerseys containing several cows with milk fever histories, it was found that when 1,000,000 units of vitamin D as irradiated yeast were fed daily for 3 to 4 weeks before freshening the changes in calcium, phosphorus and vitamin D concentration of the blood were less marked at calving time than when the unsupplemented herd ration was fed. This led to a more detailed study in three herds involving up to the present time 75 calvings of all Jersey, Guersey, Holstein and Ayrshire cows, exclusive of first calf heifers, in these herds.

Half the cows receive 1,000,000 units of vitamin D daily as irradiated yeast for 4 weeks before and one week following freshening. Blood samples are taken four weeks before the due date, within 12 hours of freshening, within 12 hours after freshening, and one week post freshening. If a cow develops milk fever blood samples are taken each day for a week.

These blood samples are analyzed for calcium and phosphorus and, when a cow develops milk fever, for acetone bodies to detect possible complications with acetonemia. Vitamin D is determined on dried pooled blood samples

of cows of the same breed freshening within a 4 to 8 weeks' period of each other and on individual samples obtained during attacks of milk fever.

In general blood calcium, phosphorus and vitamin D dropped just before calving, this change being less in yeast-fed animals. During attacks of milk fever blood calcium dropped to as low as 4.0 mg. per 100 cc. and phosphorus to less than 1.0 mg. per 100 cc. Vitamin D in the blood was also materially reduced. Whereas 1.0 gram of dried blood will normally produce 1.0 to 2.0 plus healing in rachitic rats, from 2.0 to 3.0 grams of dried blood obtained from a cow in milk fever were required to obtain the same effect. This, plus the demonstration that vitamin D changes are more marked in Jersey blood than in Holstein blood and that incidence of milk fever was much greater in Jerseys than in Holsteins, suggests strongly that vitamin D plays some role in the prevention of this disease.

P44. Nature of the Material in Mastitic Milk Responsible for the Whiteside Reaction. H. O. Dunn, J. M. Murphy, and O. F. Garrett, N. J. Agr. Expt. Sta., New Brunswick, N. J.

When sodium hydroxide is mixed with milk from mastitic udders a coagulation or gelation occurs, the intensity of which is directly proportional to the degree of infection. The nature of the reaction, known as the Whiteside test, suggests that a protein not present in normal milk is involved in the reaction.

When milk showing a positive Whiteside reaction is allowed to separate by gravity, the cream shows a strongly positive Whiteside reaction whereas the skim milk is negative. Dilution of the gravity cream to the original concentration of the milk results in a positive Whiteside reaction of the same magnitude as the original milk.

When milk showing a positive Whiteside reaction is centrifugally separated, the cream gives a negative Whiteside reaction whereas the skim milk shows a positive Whiteside which is lower in intensity than that of the original milk. Apparently the milk fat is not involved in the typical reaction with NaOH. The fact that the Whiteside reaction was positive in the gravity cream may be explained by assuming that the material involved in the reaction is loosely adsorbed by the fat globules.

Carefully controlled experiments showed that the amount of separator slime obtained from mastitic milk was many times greater than that obtained from milk of mastitis-free cows. Moreover, the slime from mastitis-free cows did not give the typical Whiteside reaction whereas that from the mastitic cows gave an intensely positive reaction. Addition of the slime from mastitic milk to Whiteside-negative milk produced a definite positive Whiteside reaction the intensity of which depended upon the amount of slime added.

A high correlation was found to exist between the intensity of the Whiteside reaction, the number of leucocytes and the amount of separator slime.

A chemical analysis of the slime from mastitic milk showed a protein content of about 68% and a phosphorus content of about 1.35% on the dry weight basis.

Calculations show that cellular material in the slime does not account for all the solid substances present, but when a suspension of equine blood leucocytes was added to non-mastitic milk, which contained no leucocytes, typical Whiteside reactions were obtained the intensity of which corresponded directly to the number of leucocytes added. This is strong evidence that the Whiteside reaction is due, directly or indirectly, to leucocytes.

P45. The Value of Tyrothricin (Gramicidin) in a Herd Mastitis Control Program. C. S. Bryan, R. E. Horwood, and C. F. Clark, Michigan Agr. Expt. Sta., East Lansing, Mich.

Until recently dairymen desiring to eradicate streptococcic mastitis from their herds have been compelled to eliminate all infected cows. At this institution 150 cows, that were infected with mastitis streptocicci but had no marked indurative changes of their udder, were treated with 150 milligrams of tyrothricin per quarter. Recoveries were obtained in 93 per cent of these selected cases treated. Sanitary measures must be employed to protect the cows without mastitis, including those recovered upon treatment, from reinfection.

P46. Experiences With Lactovaccine in the Control of Mastitis. C. F. Clark, C. S. Bryan, and R. E. Horwood, Michigan State College, East Lansing, Michigan.

A project was set up to test the value of lactovaccine as a curative agent in the treatment of chronic bovine mastitis, and as a preventive. Two herds were used in the demonstration. The microscopic examination of incubated milk samples was used to determine the presence or absence of infection.

Herd A

Group 1. Twenty-eight cows shedding streptococci in their milk were given repeated injections of lactovaccine. Eight (28%) of the cows so treated apparently recovered, as the microscopic test became negative.

Group 2. Fifty-one cows negative to the microscopic test were given repeated injections of lactovaccine to determine if it would prevent mastitis. Six (11%) of this group later became positive to the microscopic test.

Group 3. Fifty-nine cows negative to the microscopic test were used as controls to Group 2. None of these cows were given lactovaccine. Seven (11%) of this group later became positive to the microscopic test.

Herd B

Group 4. Four cows positive to the microscopic test were given repeated injections of lactovaccine; one cow recovered and became negative to the microscopic test.

Group 5. Forty cows negative to the microscopic test were given repeated injections of lactovaccine. Eighteen (45%) of these cows later became positive to the microscopic test.

Group 6. Seventeen cows negative to the microscopic test were not injected, being used as controls on Group 5. Five (20%) of these cows later became positive to the microscopic test.

Conclusion

Under the conditions of this experiment, lactovaccine appeared to have some value in the treatment of chronic bovine mastitis but did not appear to have value as a preventive measure.

P47. Mastitis and Herd Practices in the College Dairy Herd. RUSSELL E. HORWOOD, C. F. CLARK, AND C. S. BRYAN, Michigan State College, East Lansing, Mich.

In 1928 the college herd was moved into the present barn. The herd was culled drastically at that time although no systematic program of testing for infectious mastitis was in effect. A number of young outstanding animals were purchased for replacement. Many of these contracted udder infection at an early age. However, due to their outstanding type and production they were maintained in the herd a number of years. In 1938, 1939, and 1940 due to mastitis, breeding difficulties and age, many of these cows were eliminated. This accounts in part for the rapid drop in the incidence of infection at that time.

Production of Infected vs. Non-infected Quarters.[1] Quarter samples of milk from the college dairy herd were studied from July 1, 1933, to May 30, 1934. The samples were from cows with no udder infection and cows having one, two, three or four infected quarters.

In 36 non-infected cows the fore quarters produced 44.9% of the milk and 43.6% of the butterfat.

In 14 cows having opposite infected and non-infected forequarters there was a reduction of 16.4% milk and 16.8% fat in the infected quarters. A similar study on rear quarters with 9 cows showed a 32.4% reduction of milk and 32.2% reduction of fat in the infected quarters.

Methods of Testing. Monthly samples of milk from each quarter were taken and tested for infectious mastitis beginning November 1932 and continuing to February 1937. The following methods were used in detecting

[1] Unpublished data gathered by George W. Taylor.

infectious mastitis: microscopic test, chloride content, physical examination of the udder, leucocyte content, thybromol test, physical examination of milk and culture of milk and blood agar.[2]

The results of the above work lead to the adoption of the microscopic system of testing. Quarter samples from each cow in the herd were tested from June 1937 to June 1938. Composite samples were then run on the negative cows and quarter samples continued on the positive cows. Since October 1941 all quarter samples have been discontinued.

Hand vs. Machine Milking. Starting June 1937 alternate first calving two year olds were placed on hand and machine milking. In addition a number of older negative cows were carried on machine milking. This was continued through November 1940. During this time an average of 15 cows were milked by hand and 25 by machine. Six hand-milked cows and six machine-milked cows became positive to infectious mastitis. Individual machines were marked for use on only negative or infected cows. No success in controlling the spread of disease resulted until this plan was adopted.

Short Wave Diathermy. During the summer of 1939, three cows with infected udders were given 50 one-hour daily treatments with short wave diathermy. Three infected cows were also observed as controls.

Examinations of samples of milk taken at weekly intervals were made from the six cows using the Hotis and Modified Hotis test at 24-, 30-, and 48-hour intervals. We also used the thybromal test, microscopic test and chloride count. A physical examination of the udder was made. No significant variation was found in the milk or udder of either the treated or untreated cows.

Lacto Vaccine Treatment. Starting in May 1939 lacto-vaccine was used to treat twenty-six different cows. Of this number eight showed complete recovery.

Tyrothricin (Gramicidin) Treatment. Tyrothricin has been used to treat nine cows in the herd. Eight of the cows became negative to mastitis. The ninth cow was negative on one test. However, this was a continuous problem cow and died soon after the last test from systemic acute mastitis. Two others remained negative for six months and then developed systemic acute mastitis. One of these died and the other lost the functional use of her udder and was slaughtered.

Summary. At the start of this program in 1932 there were 56 milking cows in the herd. Fifty per cent of these had infectious mastitis. In May 1942 the herd contained 46 milking cows. It passed a 100 per cent clean test and has done so six of the past seven months. This was accomplished by culling the infected cows, preventing the spread of the organisms, and by recovery by treatment of 17 mastitis-infected animals as mentioned previously. There were udder disturbances of a non-infectious nature during this period.

[2] Results published in Journal of Milk Technology, vol. 2, No. 1, pp. 32–40. 1939.

MANUFACTURING SECTION

M1. The Effect of Acidity and Temperature on the Growth of Oospora Lactis Cultures.* E. R. GARRISON, Dept. of Dairy Husbandry, Univ. Mo., Columbia, Mo.

The effect of the reaction of the medium and incubation temperature on the growth of 15 selected cultures of *Oospora lactis* recently isolated from sour cream was determined by measuring the diameter of giant colonies produced on potato dextrose agar plates after seven days incubation. Individual flasks of sterilized medium at a temperature of 113° F. were adjusted to a pH of 9.0, 8.0, 7.0, 6.0, 5.0, 4.0, 3.5, 3.0, or 2.5, as determined by the glass electrode, by the addition of sterile 20 per cent tartaric acid or N/1 NaOH. After standing two hours at 113° F. the reaction was again adjusted to the specified pH (± 0.05) at a temperature of 104° F. The medium was then distributed among Petri dishes in 25-ml. portions and when the agar had solidified the center of each plate was inoculated with a platinum needle that had been dipped into a water suspension of a mold culture. Three plates of the medium from each flask were inoculated with each culture. The diameter of the colonies was measured after seven days incubation at 80° F. The average diameter of the three colonies expressed in mm. denoted the amount of growth of the culture at the particular pH concerned.

The pH curve of growth was very similar for all cultures. The diameter of the colonies of each culture was essentially the same at pH 8.0, 7.0, 6.0 and 5.0; a marked decrease in growth occurred at pH 9.0 and 4.0, while growth was slight at pH 3.0 and negative at pH 2.5. The colonies formed at pH 3.5 were only one-half to one-third as large as those produced at pH 4.0. When the cultures were grown on potato dextrose agar acidified to pH 3.5 with lactic acid the colonies were regularly larger than those produced on this medium acidified to pH 3.5 with tartaric acid; smaller colonies were produced in similar trials in which sulphuric acid was used.

The comparative rate of growth of these cultures in cream of different acidities was also investigated. Four flasks of sweet cream contained 30 per cent fat were pasteurized at 160° F. for 30 minutes, then cooled and treated as follows: (1) not treated, (2) acidified to 0.40 per cent (pH 4.90) by the addition of sterile lactic acid, (3) fermented with *S. lactis* to an acidity of 0.55 per cent (pH 4.50), and (4) fermented with *L. bulgaricus* to an acidity of 1.40 per cent (pH 3.59). Three hundred and fifty grams of each cream sample were weighed into sterile one quart fruit jars and the lids loosely replaced. One jar of each of the four samples was inoculated with 0.1 ml. of a water suspension of a mold culture then plated at once to determine the number of mold spores added. The samples were held at 70°

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station Journal Series No. 845.

F. for eight days and stirred daily with a sterile glass rod. After four days and again after eight days the mold plate count, the mold mycelia content and the per cent acidity of the samples were determined. Essentially the same amount of mold growth occurred in the untreated, acidified, and *S. lactis* ripened cream samples, while a slight reduction in mold growth occurred in the *L. bulgaricus* ripened cream with some cultures but not with others.

The temperature curve of growth of the 15 cultures was studied by measuring the diameter of the colonies produced on potato dextrose agar (pH 5.0) during seven days incubation at temperatures of 40, 45, 50, 60, 70, 80, 85, 90, 95, 100, and 105° F. None of the cultures produced visible colonies during seven days at 40° F. but growth was usually evident after 10 days. The diameter of the colonies increased as the temperature was raised from 45 to 80° F. and decreased sharply at a temperature of 95° F. The optimum temperature for most cultures was near 85° F. Two cultures made essentially the same growth at 80° as at 85° F., while four cultures produced colonies of approximately the same size at 85° and 90° F. Five cultures made a slight growth at 100° F. but none of the cultures grew at 105° F.

M2. Various Treatments Which Affect the Growth of Mold Mycelia in Cream and Resultant Butter.* J. E. EDMONDSON AND W. H. E. REID, Univ. Mo., Columbia, Mo.

This investigation is concerned with a study of the various factors affecting the development of mold in cream and butter. The following factors have been studied: time or storage period, variable storage temperatures, stirring and non-stirring of cream samples, layering and non-layering of cream samples, covered and non-covered cream samples, variable butterfat content of cream, and the comparison of wet and dry refrigeration of cream on the farm.

Storage temperature was found important to the growth of mold mycelia in cream since it multiplies rapidly at the higher temperatures due to the characteristic ability of this mold to tolerate acid. The time factor is also important; however, mold growth can be controlled by the application of a four-day delivery system to such an extent that temperature is not entirely a controlling factor.

In the study of creams of variable butterfat content, the data shows definite correlation between the rate of mold growth and the percentage of butterfat. As the butterfat of the cream was increased the mold growth diminished.

A comparison of the stirred and non-stirred samples of cream showed that the mold growth was more apparent in the stirred samples; however, in the finished butter the non-stirred samples had the highest mold count.

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station Journal Series No. 830.

The covered and non-covered samples of cream show that the covered samples have a lower mold count but that the sealing of the container covers resulted in the development of stale, musty and absorbed flavors and aroma. The absorbed flavors were transmitted by the resultant butter, thereby lowering its quality.

The layered and non-layered samples of cream gave results which definitely favor the practice of the layering of cream. The layered samples give a much lower mold count in cream and resultant butter, and may be due to the control of the air supply which is required by the mold.

Studies of the comparison of dry and wet refrigeration are still in progress.

M3. The Development of a Positive Phosphatase Test on Refrigerated Pasteurized Cream. F. W. BARBER AND W. C. FRAZIER, Dept. Agr. Bact., Univ. Wis., Madison, Wis.

Vat pasteurized cream, which gave a negative phosphatase test immediately after pasteurization, developed a positive reaction to the test after being held at 4° to 10° C. for 24 to 48 hours. Gram positive, spore-forming bacilli were isolated from each lot of cream and grew in pasteurized cream, sterilized cream and sterilized skim milk with the production of phosphatase. There was no evidence of the production of phenol or phenol-like compounds. The bacilli isolated vary somewhat in their morphological characteristics, but apparently all belong in the mesentericus group.

The phosphatase produced by these organisms appeared early in the medium and washing of the cells resulted in positive tests on the wash water.

These organisms produced phosphatase more rapidly and with fewer numbers present in pasteurized cream than in sterilized cream. Microscopic counts were one to two million/ml. in pasteurized cream but in sterilized cream, before phosphatase activity developed, counts were anywhere from 48 to 434 million/ml.

Experiments indicated that phosphatase was not protected from destruction during the pasteurization process and later liberated in sufficient amounts to give a positive test.

Present evidence indicates that the phosphatase production by these organisms is a contributing factor in the change in reaction of the phosphatase test from negative to positive on refrigerated pasteurized cream.

M4. The Keeping Quality of Cream Pasteurized at 165° F. for 30 Minutes, Variously Treated, and Stored at 0° F. E. S. GUTHRIE, Cornell Univ., Ithaca, N. Y.

Twelve lots of 12 samples each of cream pasteurized at 165° F. for 30 minutes were stored at 0° F. in sealed three-quart-tin cans. The factors studied were: homogenization, deaeration, addition of ascorbic acid, and addition of isoascorbic acid.

Flavor examinations were made after storage of 7 months, and again after 19 months. The results of the quality scores showed only slight differences.

M5. The Keeping Quality of Unsalted Butter Made from Sweet Cream Pasteurized at 165° F. for Thirty Minutes and Stored at 0° F. and 32° F. C. N. STARK, E. S. GUTHRIE, AND J. J. R. CAMPBELL, Dept. of Dairy Indus., Cornell Univ., Ithaca, N. Y.

Previous reports from this laboratory have shown the superior keeping quality of unsalted butter made from sweet cream pasteurized at 165° F. for thirty minutes. Many reports in the literature of the dairy industry show the importance of refrigeration of ordinary commercial butter at temperatures around zero degrees F.

Our laboratory findings indicated to us that butter might be satisfactorily held at appreciably higher temperatures if the more important butter spoilage factors were properly controlled.

Experiments have been conducted to obtain data on this point. Unsalted butter made from sweet cream pasteurized at 165° F. for thirty minutes has been held at 0° F. and 32° F. and judged for quality at various intervals. For the first six months of storage the butter held at 32° F. is of excellent quality as is the butter stored at zero ° F. The butters stored at both temperatures scored 93 at the end of six months' storage. The practical value of such results is obvious. These experiments are being continued.

M6. Some Observations Concerning the Ascorbic Acid Content of Evaporated Milk. D. V. JOSEPHSON AND F. J. DOAN, Pa. Agr. Expt. Sta., State College, Pa.

Four series of evaporated milk samples were obtained over a period of two years from twenty-seven different manufacturing plants in various parts of the United States. Samples were reconstituted to a fluid basis and analyzed soon after receipt and again after two and four month intervals of storage at room temperatures.

The greatest loss in ascorbic acid content apparently took place during processing and immediately thereafter. Assuming an average figure of 20 mg. of ascorbic acid per liter for the milk before processing, it was found that 50 to 95 per cent (with an average of 76.6 per cent) of the vitamin was lost during this period. In the following two months of storage the reduced ascorbic acid content was depleted an average of about 1 mg. per liter of reconstituted milk, or 5 per cent more, while during the second two month period very little, if any, further reduction was noted.

Dehydroascorbic acid analyses by hydrogen sulphide and bacterial reduction techniques, indicated that very little of this form of the vitamin was present to begin with or developed during storage.

The copper content of the evaporated milk samples analyzed in this study varied from .36 to 2.2 p.p.m. on a reconstituted basis, with an average of .78 p.p.m. Of the twenty-seven plants submitting samples, twenty, or 74 per cent were using copper vacuum pans. The seven others employed stainless steel pans, but only three of these were using stainless or non-copper auxiliary equipment.

Although the copper content of the evaporated milk varied widely, there was no correlation between the copper content and the amount of reduced or dehydroascorbic acid present, either before or after the four months storage period.

Only five of the twenty-seven plants submitting samples were not irradiating the milk, but from the limited number of comparisons available, irradiation appeared to have no effect on the ascorbic acid content of the finished evaporated milk.

The stability of ascorbic acid appeared to be somewhat greater in evaporated milk made during the spring and summer, but there was no apparent correlation between the kind or amount of stabilizing salt used and the ascorbic acid content.

The pH of the evaporated milk samples as received ranged from 6.1 to 6.35. During storage a further and progressive decrease was noted which seemed to be less marked in the case of milk made in the pasture season.

"Spangling," or discoloration characteristic of the inner surface of evaporated milk cans after processing and storage, was found to become progressively worse on holding, but cans containing milk of higher copper content generally exhibited less "spangling" than those containing milk of low copper content.

M7. Control and Verification of Vitamin D in Milk. M. J. Dorcas, National Carbon Co., Inc., Chicago, Ill.

Recognition is given to the part of the control official and his supervision of methods in establishing and maintaining the high quality of milk that is now generally available in this country. One of the best examples of this system is the control of the pasteurizing process. Vitamin D milks prepared by the irradiation process are now capable of an analogous system of control through the use of recording type meters which scientific research has shown to give an accurate guide to the potency produced and the records of which fit in well with the established methods of control now in use by the health officials.

Supplementing this constant daily check giving a record of the potency of each pound of milk handled the Vitamin D product is further checked by periodic assays or analysis of samples of the milk. The method of analysis used, that of bio-assay with rats, is satisfactory with respect to accuracy but is somewhat expensive and requires a period of several weeks. It is probable

that a rapid chemical analysis of milk for Vitamin D may become available because of progress in Vitamin D assays by chromatographic methods which are briefly described.

M8. A Voltammetric Method for Measuring the Concentration of Dissolved Oxygen in Dairy Products. G. H. HARTMAN AND O. F. GARRETT, N. J. Agr. Expt. Sta., New Brunswick, N. J.

The dropping mercury electrode method of measuring the concentration of dissolved oxygen has been applied successfully to milk. The apparatus used included an electrode assembly consisting of a capillary mercury electrode and a saturated calomel half cell, a sensitive reflecting mirror galvanometer, a photoelectric cell and amplifier, and a thread and drum recorder. The recorder marks the galvanometer deflection at minute intervals.

The relationship between the concentration of dissolved oxygen in milk and the magnitude of the galvanometer deflections was found to be linear. The concentration of oxygen, therefore, is proportional to the galvanometer deflection. The determination in milk may be made at a potential ranging from 0.8 to 1.2 volts.

The method actually determines the concentration of dissolved oxygen in the aqueous phase of milk. The comparatively slight variations in the solids content of normal milks, however, do not introduce significant errors.

A probable error of $\pm$ .03 and a standard deviation of 0.18 of the mean oxygen in 21 samples of air-saturated whole milk of varying solids composition show that the method is reliable.

The method and the instrument permit a continuous recording of the oxygen content of a sample. This feature should aid greatly in studying various oxidation reactions which occur in milk.

M9. Studies of the Mechanisms of Oxidized Flavor. W. CARSON BROWN AND FLOYD C. OLSON, W. Va. Agr. Expt. Sta., Morgantown, W. Va.

An attempt has been made to obtain an insight into the mechanism for the production of oxidized flavor in milk. Washed cream from which practically everything had been removed but the fat globules and their membranes was found to be a suitable medium for study. The presence or absence of oxidized flavor was determined by taste.

It was found that washed cream from susceptible milk did not develop an oxidized flavor when contaminated with copper, but that the same cream with from 20 to 200 mg. of ascorbic acid per liter developed a strong oxidized flavor both with and without added copper. Larger amounts of ascorbic acid were found to prevent the development of the flavor. Non-susceptible milk, produced on pasture, likewise, was found to develop an oxidized flavor under similar conditions. Added glutathione, in the presence of copper, was

found to produce an oxidized flavor. However, no evidence was obtained that thiamine, riboflavin, pyridoxine, or cysteine, were involved in the production of oxidized flavor.

Not only did reduced ascorbic acid produce oxidized flavor in washed cream but dehydroascorbic acid likewise produced it. Evidence from these experiments indicates that the two steps of oxidation of ascorbic acid are first to dehydroascorbic acid and then to oxalic acid and threonic acid. Both reactions probably reduce copper from the cupric to the cuprous form. The cuprous copper being very unstable is then oxidized by molecular oxygen to the cupric form with the production of hydrogen peroxide. The hydrogen peroxide then oxidizes the phospholipides of the fat globule membrane producing decomposition products that cause oxidized flavor.

A similar production of hydrogen peroxide by the oxidation of glutathione from the sulfhydryl to the disulfide form is indicated in the literature. Hydrogen peroxide in the presence of copper was shown to develop an oxidized flavor in washed cream. However, it is believed that one of the main mechanisms of oxidized flavor production in milk is found in the ascorbic acid.

M10. Relation of Dissolved Oxygen to Certain Oxidation Reactions in Milk. G. H. HARTMAN AND O. F. GARRETT, N. J. Agr. Expt. Sta., New Brunswick, N. J.

The application of the dropping mercury electrode method for measuring the concentration of dissolved oxygen in milk has made possible a study of the chemical oxidation reactions which occur in milk in a more exact manner than was formerly possible.

The rate of oxygen consumption by the following oxidations in milk has been studied: 1. Oxidation of ascorbic acid with and without copper contamination; 2. Development of oxidized flavor.

The ratio of oxygen consumed to the amount of ascorbic acid oxidized is about the same in uncontaminated and copper-contaminated milk. The ratio varies in different milks and ranges from 1 molecule of ascorbic acid per 1.2 to 1.6 atoms of oxygen.

When the concentration of oxygen in copper-contaminated milk is plotted against time, the curve shows a rapid decrease in oxygen so long as ascorbic acid is present. When all the titratable ascorbic acid has been oxidized the oxygen concentration remains constant for a period of time the length of which varies with different milks. At the point at which the first perceptible oxidized flavor appears a decrease in oxygen concentration occurs. There follows a slow but progressive decrease in oxygen concentration as the tallowy flavor becomes more intense. The amount of oxygen needed to produce a barely perceptible oxidized flavor is small but is considerable for the development of an intense flavor. In a sample of fresh pasteurized milk

which contained 19.45 mgs. of ascorbic acid per liter and to which copper was added, the oxygen concentration decreased from 8.58 p.p.m. at the onset of oxidized flavor to 6.85 p.p.m. when the flavor reached an intensity of T^{+++}. The corresponding decrease in oxygen in the same sample of milk to which was added approximately 25 mgs. of ascorbic acid per liter was from 5.68 p.p.m. to 3.81 p.p.m.

M11. The Role of the Oxidase Producing Bacteria in the Development of Oxidized Flavor in Milk. J. FRANK CONE AND C. J. BABCOCK, Bureau of Dairy Industry, U.S.D.A., Washington, D. C.

A study was made to determine the ability of the oxidase-producing bacteria to cause oxidized flavor in pasteurized milk. Nine strains of gram-negative rods were used in the study, each strain capable of giving a positive reaction when agar plates on which they were grown were flooded with a 0.5 per cent aqueous solution of p-aminodimethylanaline monohydrochloride. They included *Pseudomonas putrefaciens, Ps. fragi,* and seven unidentified strains which were isolated from milk. In addition an oxidase-negative strain of *Achromobacter lipolyticum* was used in some of the experiments.

Milk shown by previous studies to be susceptible to the development of oxidized flavor either spontaneously or upon the addition of not more than 0.1 p.p.m. of copper, was pasteurized in flasks at 63° C. for 30 minutes. Different lots of this milk were inoculated with the experimental organisms, either single strains or combinations of strains. The amount of inoculation was varied to give counts in the freshly inoculated milk ranging from a few hundred to several million per ml. Each freshly inoculated lot was distributed in half-pint bottles, one for examination immediately and two for examination after 2 and 4 days' storage respectively at 4–6° C. The examination consisted in tasting for evidence of oxidized flavor and plating on standard TGEM agar to determine total counts (at 20° C. incubation) and numbers of oxidase positive organisms. Suitable controls were run without inoculation, with and without the addition of 0.05–0.1 p.p.m. of copper.

No inoculated sample became oxidized except when the corresponding uninoculated control also became oxidized and the intensity of the flavor in those inoculated samples that did become oxidized was never greater than in the control. When inoculations of several million per ml. were made there was definite evidence that the organisms protected the milk against the development of oxidized flavor.

M12. Bacteriological Studies on Creamery Water Supplies. R. T. CORLEY AND B. W. HAMMER, Iowa Agr. Expt. Sta., Ames, Iowa.

Examinations of 436 samples of unchlorinated water from 70 butter plants, using the common bacteriological tests and a few additional ones,

indicated that some plant supplies regularly were satisfactory, some regularly were unsatisfactory, while others varied in quality from one examination to the next. Certain supplies that would have been considered acceptable from a public health standpoint were not suitable for use in butter manufacture. In some plants satisfactory well water was heavily contaminated in storage tanks. Some city water supplies were unsatisfactory for butter manufacturing purposes.

When water known to contain coliform organisms was used to wash experimental butter, the organisms regularly were found in unsalted butter and sometimes were found in salted butter. Commercial butter from plants using water that commonly contained coliform organisms regularly contained the organisms when unsalted and sometimes contained them when salted. As coliform organisms become more numerous in water, total bacterial counts on the water tended to be higher.

T.G.E.M. agar counts after 96 hours at 21° C. were higher than the counts on this medium after 48 hours at 37° C. The medium gave higher counts than nutrient agar after 24 to 48 hours at 37° C.

Ps. putrefaciens was found in a considerable number of water samples, while typical fluorescent organisms were found in a still larger number. Some *Pseudomonas* species known to produce undesirable flavors in butter were isolated from some water supplies. These included *Ps. fragi, Ps. graveolens* and *Ps. mephitica.*

Some water samples having high bacterial counts did not cause flavor deterioration when used to wash experimental unsalted butter, but the tendency was for samples showing high bacterial counts to be more generally associated with serious deterioration in butter than samples having low counts.

M13. Sensory Adaptation as a Factor in the Judging of Dairy Products for Flavor. S. T. COULTER, Dairy Dept., Univ. Minn., St. Paul, Minn.

It is a common experience to note that an odor which is almost overpowering when first smelled soon becomes imperceptible. This adaptation of the olfactory receptors is a definite factor in the reliability of the judgment passed on the flavor of dairy products.

Trials with seventeen individual judges showed a fairly rapid, although variable, rate of adaptation to the odor of coumarin. Most judges could readily detect initially the odor of coumarin in a 0.005 per cent aqueous solution. Following one sniff of a 0.3 per cent solution, many did not detect the odor in a 0.012 per cent solution. After as many as 3 sniffs of a 0.3 per cent solution, none detected the odor of coumarin in the 0.005 per cent solution. All judges readily detected coumarin in ice cream flavored at the rate of 4 ounces per 5 gallons of mix with a standard pure vanilla extract

to which 2 grams of coumarin per gallon had been added. If, however, a duplicate sample of the same ice cream was preceded by two samples flavored with the same amount of an extract containing 60 grams of coumarin per gallon, the sample was quite uniformly picked as one flavored with pure vanilla.

Similar results were secured in the judging of butter and cream flavored with garlic.

M14. A Quick, Colorimetric Method for Estimating the Quality of Butter. E. S. GUTHRIE AND GEORGES KNAYSI, Cornell Univ., Ithaca, N. Y.

A simple method of estimating the quality of butter is described. It consists in dissolving 1 ml. of the melted milkfat in chemically pure xylol saturated with the base of neutral red, and comparing the color with standards containing known quantities of oleic acid. The preparation of the base of neutral red is described.

The test, which is a measure of the degree of the hydrolysis of the milkfat, is found to be of value in quickly detecting bad samples, and the majority of fair or good samples of butter, and in adding precision to the judgment of the expert. Over 100 samples of butters of various qualities were examined.

M16. Forewarming Temperature of Plain Condensed Skimmilk and Properties of the Resulting Ice Cream. JACK B. CLINCH AND J. H. ERB, Dept. of Dairy Technol., Ohio State Univ., Columbus, Ohio.

The variations in properties of ice cream caused by using plain skim condensed milks subjected to different forewarming temperatures were studied.

Raw skimmilk was divided in three lots and forewarmed in a jacketed stainless steel hot well for twenty minutes at 160° F., 180° F. and 200° F. Each lot of milk was then condensed to 40% solids in a 16-inch stainless steel vacuum pan. Relative viscosities were determined upon each sample at several concentrations between 30% and 40% total solids. In some trials the milk was condensed to 30% solids content.

The viscosity results indicated that the higher the temperature of forewarming the greater was the viscosity of the milk when condensed to 40% solids. There was a marked difference in the viscosity of 40% condensed milk preheated at 160° F. and that preheated at 200° F. The viscosity of that preheated at 180° F. was midway between the other two.

When the condensed milks were incorporated into ice cream mixes, as the chief source of serum solids, differences could be detected in the resulting ice cream depending upon the heat treatment of the skimmilk. In general,

the preheating temperature of 200° F. imparted to ice cream a more resistant, or "chewy" body, and produced a product that melted smoother and slightly more rapidly. This was especially significant when the condensed milk was condensed to 40% solids. The results indicated that lactose crystallization developed more rapidly in the ice cream containing the condensed milk forewarmed at 200° F. Little difference in flavor was noted in the mixes with the various heat-treated condensed milks.

M17. Relation of Different Mix Compositions and Methods of Processing to the Texture, Structure and Stability of Ice Cream.* C. W. Decker and W. H. E. Reid, Mo. Agr. Expt. Sta., Columbia, Mo.

Based upon a standard mix containing 1 per cent of sucrose, a partial replacement of sucrose with dextrose was made as follows: 15 per cent sucrose (0 replacement), 1¼ per cent sucrose, 3¾ per cent dextrose (25 per cent replacement); 10 per cent sucrose, 5 per cent dextrose (33⅓ per cent replacement). Mixes of variable compositions of 11 per cent serum solids—12 per cent butterfat, 11 per cent serum solids—14 per cent butterfat, 13 per cent serum solids—12 per cent butterfat, and 13 per cent serum solids—14 per cent butterfat were also studied.

Drawing temperatures of 24° F. in the batch freezer, and 24° F., 23° F., 22° F. in the continuous freezer were used to determine their relation to the physical properties of ice creams.

Thin sections of ice cream of 10 to 15 microns in thickness were prepared and immersed in an immersion media of ethyl acetate and photomicrographs taken. Fifty or more measurements were made from each photomicrograph to determine the ice crystal, also air cell, size, distance between ice crystals and distance between air cells. An average was determined from the fifty or more measurements and an analysis of variance made statistically with the data.

A table of recommended drawing temperatures based upon observations of the ice cream when drawn from the freezer and ice crystal sizes from microscopic studies was drawn up for the mix compositions studied.

It was found that as the drawing temperature was decreased from 24 degrees Fahrenheit to 22 degrees Fahrenheit the size of the ice crystal decreased markedly. This resulted in an ice cream with a smoother, finer texture and structure.

Variations in the composition also had an important influence upon the texture and structure of ice cream. The difference between a 25 per cent and 33⅓ per cent replacement of sucrose with dextrose was not sufficient to give consistent distinctions of the ice crystal size of the resultant ice creams. An increase in the serum solids content from 11 per cent to 13 per cent did not

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station Journal Series No. 831.

have as important an effect on the ice crystal size as did an increase of butterfat from 12 per cent to 14 per cent. The increase of butterfat content resulted in a finer ice crystal and a smoother texture in the ice cream.

The influence of variations in composition upon the meltdown properties of the ice cream was quite apparent. An increase in butterfat gave a meltdown which was characterized by sluffing off, and a coarse external appearance. An increase in the serum solids content gave a desirable, smooth meltdown characterized by a melting of the ice cream to the original mix. The variations in drawing temperatures did not have any visible influence upon the meltdown appearance of the ice creams.

M18. The Gases Evolved by Cheddar and Limburger Cheese.* F. L. DORN AND A. C. DAHLBERG, New York (Geneva) Agr. Expt. Sta., Geneva, N. Y.

The ripening of natural cheese in tight tin cans made it convenient to study the volume and composition of the gas evolved during the curing process.

The volume of gas produced by cheddar cheese was more uniform and much less when made from pasteurized milk, especially when cured at 40° F. The evolution of gas was most rapid during the first month of curing but it did not cease completely even after one year.

The oxygen in atmospheric packed cheese disappeared in one week at 60° F. but 7 weeks were required at 40° F. The gas evolved from the cheese was nearly pure carbon dioxide with traces of hydrogen. The loss in weight of the cheese due to the carbon dioxide evolved varied from .13 to .20% for raw milk cheese and .04 to .09% for pasteurized milk cheese. The milk was of market milk quality. The gas evolved per pound of cheese made from raw milk varied from 307 to 491 ml. in 44 weeks at 50° F. and 254 to 296 ml. at 40° F. For pasteurized milk cheese the volume of gas was 121 to 197 ml. in 44 weeks at 50° F. and 86 to 87 cc. at 40° F.

Gas formation in commercial raw milk Limburger cheese was much greater than in cheddar cheese. When the Limburger cheese was partially cured before canning the gas was 90 to 95% carbon dioxide and 5 to 10% hydrogen. Fresh Limburger curd produced gas that was 95 to 97% carbon dioxide. The partially ripened Limburger cheese when canned produced from .8 to 3 liters of gas per pound of cheese in 18 weeks at 50° F. and .3 to 1.3 liters at 40° F. This volume of gas represented a loss of .6 to 1.2% of the weight of the Limburger cheese.

M19. The Preparation of Crystalline Rennin. C. L. HANKINSON, The Carnation Research Laboratories, Milwaukee, Wis.

Previous progress in the purification of rennin from commercial rennet

* This investigation was supported by Bankhead-Jones funds.

extract (JOUR. DAIRY SCI., **25**: 277 (1942)) resulted in the isolation of a highly purified, though not crystalline, enzyme concentrate. Continued study has resulted in actual crystallization of the enzyme.

The principles of purification employed were isoelectric precipitation from salt solutions, centrifuging and dialysis. Precipitation from saturated sodium chloride solutions at pH 5.0 rather than from 16.7 per cent sodium chloride solutions at pH 4.5 had the following advantages: (1) a higher potency product, (2) less total losses of active material, and (3) less difficulty with amorphous material in the subsequent crystallization procedure.

The highly purified rennin concentrate was dialyzed, diluted to a solids concentration of 0.05 per cent, filtered and the pH adjusted slowly to 4.5 with N/10 HCl. Rennin crystallized out as long white needles and after standing several hours at room temperature the white crystalline material was centrifuged off. Recrystallization may be effected by repeating the crystallization procedure but this has been found to be unnecessary because of losses of active material with no further increase in activity per unit weight.

Care should be taken in the crystallization procedure to prevent precipitation of amorphous material which may result from the following:

(1) Too rapid addition of acid.
(2) Solids content greater than 0.05%.
(3) Insufficient purification prior to crystallization.
(4) Room temperature greater than 20 to 25° C.

Some of the chemical properties of pure renin will be reported.

M20. The Use of Rennet Paste in Romano-Type Cheese. C. A. PHILLIPS, G. A. RICHARDSON, AND N. P. TARASSUK, Univ. Calif., Davis, Calif.

Domestic rennet paste from three different sources, and one sample of imported Italian paste, were compared with liquid rennet in the manufacture of Romano-type cheese.

Since April 1941, fifty-four cheese have been made, the average cured weight of each being approximately 20 pounds. Holstein milk, partially skimmed, was used, a stirred curd produced, the cheese dry or moist salted, and cured at 55° F. A mixture of cottonseed oil and black pepper was applied to the surface of the cheese at approximately one month intervals during the curing process.

The cheese was analyzed for milk fat, total solids, and salt. Determinations for pH value were made during the curing process. These analyses conformed very closely to that of one sample of imported Italian Romano cheese which was as follows: total solids, 63.03 per cent; milk fat, 39.2 per cent in the dry matter; salt, 5.87 per cent; pH value, 5.13.

The cheese made with liquid rennet was totally lacking in typical Romano flavor. All samples of rennet paste used produced cheese with a desirable

piquant flavor, similar to that in the Romano cheese imported from Italy. Homogenization of the milk or the addition of steapsin caused the development of excess piquancy when rennet paste was used.

The voltaile acid production in the cheese made by the various procedures was determined using an extraction method.[1] The results indicate that the increased piquancy induced by rennet paste over liquid rennet is due to a greater production of volatile acids rather than to a specific lipolysis. There is reason to believe that homogenization of the milk as well as the addition of steapsin produces not only a greatly increased lipolysis, but also an accelerated liberation of the volatile insoluble acids.

M21. Studies Relating to the Canning of Pasteurized Milk Cheese. A. C. DAHLBERG AND J. C. MARQUARDT, N. Y. Agr. Expt. Sta., Geneva, N. Y.

The principal problem to be overcome in the successful canning of natural cheese is the disposition of the evolved gas. This has been successfully done with the vent can but not with the less expensive conventional tin can used in these experiments.

There are several important factors that are involved in curing cheese in the ordinary tin can. The cheese should be made from cheese-milk of good quality. The milk should be pasteurized to destroy most of the gas-producing bacteria. The cheese should be well made without excessive moisture and packed with 20 to 25 inches of vacuum. The vacuum aids by serving as a buffer area to take up some of the gas. The rate of gas formation is least with cold curing. Finally, to secure most permanent assurance against gas pressure, a small amount of calcium or magnesium hydroxide may be placed in the cans to combine with the carbon dioxide evolved during ripening.

Natural cheese may be vacuum packed and ripened in the cans for 4 to 6 months and then held for 1 to 2 weeks at room temperature without developing excessive gas pressure, providing the conditions mentioned above are adhered to. When the calcium or magnesium hydroxide is present in the can the curing time may exceed a year. There appears to be a satisfactory margin of safety in this process to permit commercial usage providing the package is marked perishable to be held cold. It is obvious that gas formation by process cheese is not a problem in canning.

M22. Comparative Studies on Cheddar Cheese Prepared with Starter and with Certain Pure Cultures.[2] D. D. DEANE AND T. G. ANDERSON, Dept. Bacter., Pennsylvania State College, State College, Pa.

All cheeses studied in this investigation were made by the usual com-

[1] Hiscox, Harrison and Wolf. Jour. Dairy Res., 12: 155. 1941.

[2] A phase of a cooperative study with C. D. Dahle and F. G. Warren of the Department of Dairy Husbandry.

mercial method from raw milk with a fat content of 3.6 to 3.7 per cent. Curing temperatures of 43° F. and 63° F. were used. The various cultures used as "starter" were *Str. citrovorus, Str. paracitrovorus, Str. lactis,* a commercial starter and an as yet unidentified acidoproteolytic micrococci isolated from a 4-year-old cheddar cheese.

By bacteriological study it was found that the highest counts were found when the first sample was taken when 1 day old. The number of microorganisms decreased steadily from this point on as the cheese aged. *Str. lactis* made from 90 to 99 per cent of the streptococci found which were predominate throughout the period the cheeses were examined. The temperature of curing had no significant influence upon the bacterial flora of these cheeses.

Str. citrovorus produced a cheese with a bitter flavor when used in conjunction with a commercial starter or a pure culture of *Str. lactis. Str. paracitrovorus* under these same conditions produced a slightly more desirable cheese from the standpoint of flavor. In conjunction with a commercial starter the flavor score remained at a comparatively high level, but this did not hold true when used with *Str. lactis.* There was no indication that the curing period could be significantly shortened by the use of any of the above pure cultures of streptococci as starters.

Cheese prepared with a commercial starter supplemented with the micrococcus isolated and used in this study received a flavor score after three weeks of from 0.5 to 2.0 points higher than the control cheese made with commercial starter. The body of the cheese prepared with the micrococcus is also superior after 3 weeks curing.

Studies on curing temperatures indicate that cheeses held at 63° F. for four weeks and then placed at 43° F., attain a higher flavor score sooner than cheeses held at 43° F. only. The flavor score of the higher temperature cheese was not, however, maintained as long nor was the maximum flavor score reached ever as high as that ultimately reached by the 43° F. cheese.

M23. General Action in Cheese of an Enzyme Preparation from Chicken Stomach. F. J. Babel, G. F. Stewart, and B. W. Hammer, Iowa Agr. Expt. Sta., Ames, Iowa.

An enzyme preparation that coagulated milk was prepared from the proventriculi of fowls for use in experimental cheese. Washed, minced glands were treated with an equal quantity of water and sufficient concentrated hydrochloric acid to obtain a pH of 1.5 to 2.0. After digestion for 18 to 24 hours at 40° C., an equal volume of ice water and 2 per cent talc were added. The mixture was allowed to settle at 0° C. and the supernatant liquid was removed. This was concentrated by evaporation at 25° C. or the enzyme solution was further purified by filtration and precipitation by

saturation with sodium chloride. In special tests purified preparations clotted milk in a concentration of 1 : 250,000 and showed appreciable digestion of coagulated egg white in a concentration of 1 : 100,000. The enzyme solution was quite stable in liquid form.

When 35 ml. of the enzyme preparation per 100 pounds of milk was used in the manufacture of cheddar cheese, the milk formed a firm coagulum in approximately 30 minutes. During the cheddaring process the curd began to show evidence of proteolysis and the curd was somewhat soft. Progressive softening occurred throughout the ripening period. The cheddar cheese made with the enzyme preparation had a bitter flavor and the bitterness persisted throughout the ripening period.

Edam type cheese made with the enzyme preparation showed a rather soft coagulum as compared with rennet coagulation, but the curd acted normally. Cheese made by this method had a soft, smooth, waxy body. The cheese were rather bitter in the early stages of ripening, but the bitter flavor tended to disappear as the cheese were held.

THE THIRTY-SEVENTH ANNUAL MEETING OF THE AMERICAN DAIRY SCIENCE ASSOCIATION

R. B. STOLTZ

Secretary-Treasurer

The American Dairy Science Association assembled in Fairchild Theater on the campus of Michigan State College in East Lansing, Michigan on Tuesday, June 23, 1942 at 9:00 A.M.

Past President Earl Weaver called the meeting to order and President Judkins introduced the officers of the Association.

Vice-President H. P. Davis then introduced the following Past Presidents: J. H. Frandsen, E. O. Anderson, A. A. Borland, O. E. Reed, J. B. Fitch, J. M. Sherman, E. L. Anthony, H. C. Jackson, R. B. Stoltz, H. A. Ruehe, H. W. Gregory, Earl Weaver, and E. S. Guthrie.

Secretary Stoltz introduced the following members who had served the Association as Directors: C. R. Gearhart, E. G. Hood, J. H. Nelson, and Harold Macy.

J. A. Hannah, President of Michigan State College, was then introduced and delivered the address of welcome.

President H. F. Judkins gave the following response:

PRESIDENT'S ADDRESS

"President Hannah, your words of welcome are very much appreciated although I can assure you that this group already feels very much at home on your delightful campus. Professor Weaver and his associates are proving themselves to be shining examples of Michigan hospitality. We know that when we leave you it will be with a desire to return. We shall endeavor to behave well while we are here. We wouldn't dare do otherwise as a glance at the map of your state shows that you have us right under your thumb.

"Even in these difficult times when everyone is busily engaged in an all-out war effort, progress demands that we keep abreaest of the times and also that we take an occasional furlough for recreation. This, the 37th Annual Meeting of the American Dairy Science Association, provides an opportunity for the leading minds in the dairy industry to take an inventory of the events of the past year and to renew that spirit of good-fellowship so characteristic of the meetings of this Association. I am glad so many have been able to take advantage of this opportunity in spite of summer teaching schedules and travel difficulties.

"I have said that this group represents the leading minds in the industry because a person must be a graduate of an agricultural college or hold a responsible position in the industry requiring a technical knowledge of dairying to be eligible for membership. Our active membership now numbers

over 1200. About two-thirds of this number are engaged in milk production and processing and the balance are engaged in teaching, research and extension activities. In other words, one-third of our membership supplies the ammunition that keeps the remaining two-thirds forging ahead. Our program, consisting of scientific reports and practical symposia will, I am sure, provide something of interest and value to all.

Position of the Dairy Industry in the War Effort

"I want to say a word concerning the place of the dairy industry in the war effort. As you doubtless know, scientific research has long since established the fact that milk and milk products are absolutely essential to the growth and well-being of the human race. Our army and navy officials have placed milk and its products at the very top of the "must" items in the ration of the armed forces of our country. The vast population of this country who are now working harder than ever in an all-our war effort must take every precaution to preserve their health. Therefore, they need a liberal supply of dairy products more than ever.

"We who are assembled here should feel fortunate that we are engaged in an industry which is so essential to the war effort. Let's remind ourselves of this fact if we wonder, from time to time, whether we are doing all we can or what we should be doing to help win the war. Certainly any person who is trained or who is training others in the production, processing and handling of milk and its products and who is now employed in the dairy industry has every reason in the world to remain in that industry with a satisfied conscience that they are a very important cog in the war machinery.

Industry Adjustments Caused by the War

"The war has naturally caused many adjustments in the educational program of our colleges and universities as well as on the dairy farm and in the milk processing industry.

"In order that more students may complete their college course before entering the service of their country, many universities, including state universities and agricultural colleges, have speeded up their program so that students may attend the year round and complete their course in two and two-thirds to three years. Some who might normally be attending this meeting are now busy in the classroom or laboratory. If the war should continue through another year, the opportunity for work in the industry will be so great that college enrollment is likely to be further reduced unless young people are drafted by the government and required to attend college at least until of military age. This plan has already been suggested.

"The war is changing to some extent the type of dairy research projects. Thus, emphasis is placed on such work as raising calves with the minimum amount of milk, obtaining the maximum output per cow with the minimum

input, industrial uses for milk by-products such as casein fibre, the possible use of various whey products in making lacquer coating as a substitute for tin, in making a rubber substitute, and in making a glycerine substitute, all of which projects hold promise. Emphasis is also placed on improved methods of manufacturing, packaging and storing such products as milk powder, evaporated milk and butter, all of which are greatly needed by the armed forces of the United Nations and will continue to be needed by the world population after the war is over. Government requirements for cheese, evaporated milk and powdered skimmilk have caused a marked increase in milk production and a shift in milk processing operations notably from butter making to cheese making.

"Lend-lease dairy supplies delivered to representatives of the United Nations since April 29, 1941 when the program started, to April 1, 1942 were as follows: Cheese, 163,953,774 pounds, Dry Skimmilk, 37,531,974 pounds; Evaporated Milk, 577,486,469 pounds. June milk production in this country is expected to reach 5,800,000,000 quarts, the largest monthly total ever recorded. The 1942 production may reach the all-time record of 56,000,000,000 quarts compared to a 1936–1940 yearly average of 49,000,000,000 quarts.

"Fresh milk and dairy products are being used in increasing quantities by the armed forces. Fresh milk is served daily to soldiers for the first time in history. Distribution of milk to the army is a man-sized job that is being successfully performed by the industry. Munitions plants are increasing the distribution of milk between meals as a means of decreasing fatigues and strengthening workers. The importance of milk in war time is further emphasized by the British experience where milk distribution has been carried on despite bombs and blitz.

"Prices received by United States dairy farmers are at the highest levels since 1930. Farm cash income from milk in 1941 topped all previous highs totaling $1,859,783,000. Present estimates indicate 1942 will total more than $2,000,000,000, an all-time high record.

"The milk and milk products industry is endeavoring to cooperate 100% with the various government agencies although it causes much burning of midnight oil to figure out ways and means of carrying on under the several government orders and recommendations. As of May 26 more than sixty orders, regulations or recommendations, all having some effect on the dairy industry, had been issued. Others, of course, may be expected as the situation changes. The effects on the dairy industry of some of the orders or recommendations are as follows: Effective as of June 1 it became necessary to take steps resulting in at least a 25% saving in mileage. This has meant radical changes, particularly in the distribution of milk and ice cream where many a horse and wagon is replacing a truck and where every-other-day delivery has become quite a common practice. New tires are, of course, out of the question, and the extent to which delivery services may be affected

if the war is prolonged cannot be foreseen at this time. The ice cream manufacturer is now limited, on a two months' basis, to 70% of the cane or beet sugar used in the equivalent two months of 1941. There have also been some recent limitations on the amount of honey available for use in ice cream. To date, through changes in formula, the ice cream manufacturer has been able to get along successfully by using refined corn sugar and syrups. Processors of cocoa beans are permitted to grind, in any one month, only 70% of the quantity of beans ground in the similar month of 1941. As inventories are reduced, the ice cream industry will feel the effects of this order. There is a question as to whether dairy plants will, especially on the eastern seaboard, be able to get enough fuel oil to operate their boilers. This is causing some change from oil to coal and the building up to stockpiles of coal by these plants as well as by those now using coal. For some time aluminum has not been available for dairy equipment or bottle closures.

"A price ceiling—the maximum prices charged to the same class of customer during the month of March, 1942—has been placed on the retail sales of fluid milk and fluid cream and on wholesale and retail sales of ice cream. All standard grades of milk, flavored milks and cultured milks and various types of cream, as well as all flavors and grades of ice cream, sherbets and novelties, etc. come under the price ceiling. New or used plant equipment cannot be bought or sold without the specific approval of the Director of Industry Operations if it has a value of $300 or more. Plant equipment may be repaired and maintained in working condition without expansion or improvement through the use of preference ratings. Buildings may be repaired and maintained in working condition without expansion or improvement up to an expenditure of $5,000 in any twelve months' period. If the amount exceeds this, approval of the War Production Board must be had before beginning the project. Electric cabinets for the storage of ice cream, milk or other frozen foods may not be sold or installed except upon approval of the War Production Board. Fourteen and one-half-ounce cans for evaporated milk are available since evaporated milk is classified as a primary product. The 6-ounce cans, however, are restricted to a fraction of the 1940 use of these cans. Retinning of milk or ice cream cans is still permitted.

"I do not wish to leave the impression that the industry is complaining of its lot, but these examples will serve to illustrate that in our industry 'Business is not being carried on as usual.'

The College Graduate's Future in the Dairy Industry

"For the balance of my time I want to discuss the role of the college graduate in the dairy industry. My twelve years of teaching experience plus my experience in interviewing and working with college graduates in dairying for more than fifteen years has caused me to be greatly interested in this subject. While you who are teachers have a great opportunity and

responsibility in training men for the dairy industry, the industry has an equally great responsibility in the proper selections of these men and in training them for responsible positions. During the past year while serving as your president I have attempted through correspondence and addresses to help improve the understanding on the part of both teacher and plant operator concerning the opportunities in the industry and the training and selection of men to take advantage of these opportunities. I talked on this subject at the meeting of the International Association of Ice Cream Manufacturers at Toronto last October. I have also appeared before students and faculty groups at Rutgers, University of Maryland, University of Minnesota, Iowa State College, University of Wisconsin, University of Illinois, Purdue University, Pennsylvania State College and Ohio State University. The list might have been longer had the times been more normal. I want to say that I very much appreciate the hospitality shown me on the occasion of these various visits. I enjoyed them thoroughly.

"The two L's, labor and legislation, have in the last ten years greatly increased the need of college trained men in the dairy industry. May I simply call to your attention some of the principal opportunities other than those of teaching, research and extension work that exist in our industry. Some of those in the production field are dairy farm managers, dairy farm owners, feed manufacturing and sales, breed association work, milk producers organization work and the publishing field. To take advantage of these opportunities one needs to have a full understanding of the feeding, breeding and veterinary care of dairy cattle. Among other things he needs supporting courses in the raising of crops, economics, and in milk processing.

"Some of the opportunities for key positions in the milk products field in addition to teaching, research and extension work are inspectors and sanitary engineers for the Federal government, State and City governments and commercial concerns, State Dairy Commissioners, the manufacture of dairy equipment, the sale of dairy equipment, work with the National Dairy Council, trade association work in the various branches of the dairy industry and dairy periodical publishing. In the commercial dairy business the following are some of the more important opportunities: research and laboratory technicians, plant superintendents or production managers and purchasing agents, office managers including the supervision of such departments as accounting, auditing, insurance, tax and treasury, legal advisers, company presidents and business owners. It will be observed that the above mentioned positions call for different types of minds and minds trained along a variety of different lines. The work, for example, of a plant superintendent is quite different from that of a man engaged in the sale of dairy equipment. In a like manner the work of an engineer is quite different from that of a sales manager and the work of a laboratorian is quite different from that of a lawyer or an accountant.

"It becomes increasingly evident that the college course in the junior and senior years should be quite flexible and that the head of the dairy department has a real opportunity to offer vocational guidance in order that each of his students may take that combination of courses which best fits his particular aptitude. Even then it appears probable that the industry may expect to select some of its men from schools of engineering, law or business administration. I am certain, however, that if men from such schools can have had some dairy work when they enter the industry they will find it very much to their advantage. It seems to me, therefore, that no time or opportunity should be lost in our state colleges and universities for the dairy department and various other departments mentioned above to cooperate to the fullest extent, helping to train the men needed in the industry. Some students majoring in economics or the school of business administration will do well to elect some undergraduate courses in dairying or do graduate work whereby their training in business is applied in the dairy field. There is less opportunity for the men majoring in the sciences and engineering to take undergraduate courses in dairying but some of these men will do well to pursue graduate work and at that time to take some courses in dairying and apply their training in this field. The industry can well afford to use more of these five, six and seven year men so trained.

"I understand dairy departments are requiring less vocational training in the laboratory for four-year men and I certainly believe that this is a step in the right direction. As a matter of fact, many four-year dairy graduates seem to be better at working with their hands than with their heads. I notice that even after some experience, they frequently do not have the knack of planning a day's production schedule, or the ability to plan an attack looking toward the solution of a plant operating problem or a product quality problem. Perhaps the reasons lie in the following statements quoted from a recent letter from one of our members who is engaged in teaching and research work. He states:

(1) 'Too many of our students are trained to accept a series of recipes for the solution of their problems rather than to exercise judgment in the application of sound, scientific principles to existing and new problems.'

(2) 'Too many of our students accept their college degrees as a trademark of a finished product rather than a token of an educational apprenticeship in a professional career, the success of which in a progressive industry is dependent upon eternal alertness.'

"Need I say that everything possible should be done to help develop the student's personality since this is likely to count for as much or more in his success than what he learns from the textbook. In this connection I should be remiss if I did not point out one weakness of many dairy graduates. It is that they are not careful enough about their personal dress and habits and that they lack the knack of being a good plant housekeeper. I know of

no one thing that so much stands in the way of a man's success in dairy plant work. Teachers and dairy instructors will do well to bear down on this side of the student's training and if the student simply cannot be made to appreciate cleanliness, the suggestion had better be made that he major in vegetable gardening where he can really get right down in the dirt.

"Someone has said 'A college education makes a good man better and a fool a bigger fool.' This at once implies that industry has a job in selecting the wheat from the chaff when employing these men and by no means should we condemn the whole lot because we sometimes get a dud. There is certainly room for improvement in the selection and developing of college graduates in the average dairy company. As I see it, this is due to two things: First, the dairy industry consists of a very large number of relatively small operating units. There are no General Electrics, Westinghouses, A. T. & T.s or U. S. Steels in the dairy business; hence the need for college trained men per operating unit is less in our industry and what is more significant we do not have the personnel machinery for selecting and training the men that is used by the large companies.

"In the second place, when hiring a college graduate, many dairy executives do not, unbeknown to the graduate, have a responsible job in the company in mind which he expects said graduate eventually to fill if he develops properly. In other words, the hiring of these college men is more or less hit and miss, and frequently quantity rather than quality is employed.

"I cannot overemphasize the importance of interviewing men before they graduate and of trying to select the best for the jobs in question. Summer employment may well be used as a test of the ability of those selected. Having selected the man, the employer should really get acquainted with him and not proceed to forget him as soon as he is hired. Obviously the employer cannot make his plans for this man too obvious, neither can he afford to pamper him in any way. On the other hand, a little advice and guidance once in a while will often help to develop a good man that might otherwise get lost in the shuffle.

"I strongly recommend the use of an employee experience record which will be printed as a part of this address. By the use of this record a man is graded every six months or so during the early years of his employment and the record speaks for itself. If it is not good he will be dropped before he has wasted the best years of his life getting nowhere. If it is good, he will be advanced as fast as the opportunity permits. It is the only sensible plan for both the employer and the employee.

"In my visits to the several institutions seniors in dairying have asked me what their chance was likely to be in the dairy industry since they were going to have to enter the service of their country. My reply has been that other things being equal the maturing effect of their life in the armed forces would be sure to be an asset to them and that they would have this advan-

EMPLOYEE EXPERIENCE RECORD*

(Ice Cream Business)

Company ..... Plant ..... Date .....
Name of Employee ..... Age ..... Height ..... Weight ..... Married or Single .....
Education and Experience before Employment .....

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
WORK CLASSIFICATION Date												
1. Procurement of raw materials												
2. Receiving and handling raw materials												
3. Preparation of flavors and colors												
4. Mixing												
5. Laboratory work												
6. Freezing												
7. Novelties												
8. Fancy department												
9. Care of hardening room												
10. Container washing												
11. Cleaning equipment												
12. Power plant and refrigeration												
13. Equipment maintenance												
14. Laundry operation												
15. Shipping												
16. Delivery												
17. Selling												
18. Garage operation												
19. Cabinet department												
20. Stock room maintenance												
21. Purchasing												
22. Accounting												
TYPE OF WORK DONE:												
1. Laborer												
2. Foreman												
3. Superintendent												
4. Salesman												
5. Plant Manager												
QUALIFICATIONS & QUALITY OF WORK DONE:												
1. Honesty												
2. Employee relationships												
3. Punctuality												
4. Health												
5. Energy												
6. Thoroughness												
7. Originality												
8. Cost Mindedness												
9. Personal appearance												
RATE OF PAY:												
REMARKS:												

* Employees record should be examined by consulting his supervisor at least every 6 months for the first 2 or 3 years. Opposite date write period covered between such examinations such as 1/1/41 to 7/1/41. For each period place an (X) in the space opposite the work that occupied major part of time and a ( ) for part time work. At each period check employee's classification under "Type of Work Done." Mark G—good, F—fair, P—poor for each period opposite "Qualification and Quality of Work" items. Note opposite "Rate of Pay," rate of pay at starting date and note date when any change made and the new rate.

tage over the younger men graduating at about the time they get out of service. I am sure that the industry will not forget them when they can change the khaki or blue for the white uniform once more."

O. E. Reed, Chief of the Bureau of Dairy Industry and who was head of the Dairy Department at the host institution fifteen years ago when the Association held its meeting there in 1927, gave an address, "The Foster Mother."

There were 212 members present. The meeting adjourned at 11:20.

GENERAL MEETING OF THE AMERICAN DAIRY SCIENCE ASSOCIATION EAST LANSING, MICHIGAN, JUNE 25, 1942

President Judkins called the meeting to order at 3:30 P.M. in Fairchild Theater, there being 114 present. Secretary Weckel of the Manufacturing Section presented the following report. Upon motion duly seconded the report was accepted.

MANUFACTURING SECTION

Papers Presented: The papers scheduled on pages 13–15 of the Program were presented as listed with the following exceptions: Paper A (June 23 section) was presented by J. F. Devine of the War Production Board at the request of Clyde Beardslee. Papers M-7, M-13, and M-15 were omitted due to absence of the speakers. Paper A (O. A. Ghiggoile, June 24) was read by E. H. Parfitt. Under A (June 24) the Chairman invited Commander A. W. Fuchs to speak extemporaneously on the operation of the dairy section of the U. S. Public Health Service.

Business meeting, June 24, 1942: L. H. Burgwald presided.

Burgwald presented a request of the Board of Directors of the Association that the Manufacturing Section consider a change in the tenure of officers. They recommend that the term of office expire July 1 of each year. Motion was made by O. F. Garrett and seconded by E. F. Hansen that newly elected officers of the Manufacturing Section assume office beginning July 1 of each year. Motion carried.

Report of Committee on Reorganization of Committees: Burgwald presented a report of the Committee on Reorganization of Committees, presented by R. Whitaker. Acceptance of the report (Appended) was moved by M. E. Parker and seconded by A. W. Farrall, and unanimously adopted.

On Election of Officers: H. Macy suggested that the method of election of officers of the Manufacturing Section was not satisfactory in that the election was held at the termination of a day's meeting when attendance was not representative. He suggested further that it would be preferable to have the election of Section Officers by mail ballot at the time ballots for election

good, F—fair, P—poor for each period opposite "Qualification and Quality of Work" items. Note opposite "Rate of Pay," rate of pay at starting date and note date when any change made and the new rate.

of Association Officers are submitted to the entire membership. It was moved by H. Macy and seconded by M. E. Parker that a Committee of three be appointed to study this matter in collaboration with officers of other sections. Motion carried. Chairman Burgwald appointed a Committee on Election of Manufacturing Section Officers consisting of H. Macy, H. H. Sommer, and E. S. Guthrie to study the matter and to report at the next annual meeting of the Society.

Election of Manufacturing Section Officers: C. J. Babcock, Chairman, read the report of the Nominating Committee. The report was accepted. Paul F. Sharp, Cornell University, was elected vice-chairman and R. J. Ramsey, Cleveland, Ohio, was elected Secretary. Vice-Chairman R. Whitaker by rule, automatically becomes Chairman of the Manufacturing Section.

Report of Business Meeting, Manufacturing Section, Thursday, June 25, 1942: R. Whitaker proposed an amendment to the Report of the Committee on Reorganization of Committees of the Manufacturing Section as follows: Creation of two additional committees; a Committee on Evaporated Milk; a Committee on Dried Whole and Dried Skimmilk; and further, that all products not specifically mentioned for listed committees be included in products under direction of the Committee on By-Products. The motion was seconded by H. Macy and unanimously adopted.

Report of Committee on Chemical Methods of Analysis: L. C. Thomsen presented the report of the Committee on Chemical Analyses appended herewith. Thomsen recommended that in the reappointment of committee members that the Committee (Subcommittee) on Skimmilk, Buttermilk and Whey be continued as it now exists so that work now in progress may be brought to completion. It was moved by Thomsen and seconded by Nelson that the report of the Committee be adopted. This was unanimously adopted.

Report of the Committee on Judging of Dairy Products: E. L. Fouts presented the report of the Committee on Judging of Dairy Products, appended. Fouts moved acceptance of the report, which was seconded, and unanimously adopted.

Report of the Committee on Score Cards for Dairy Products: C. J. Babcock presented the report of the Committee on Score Cards for Dairy Products, appended. Acceptance of the report was moved, seconded, and unanimously adopted.

Report of the Committee on Oxidized Flavor: No report.

Report of Committee on Methods of Determining Color of Milk: No report.

Report of the Committee on Comparison of the Gerber and Babcock Tests: J. H. Erb presented the report of the Committee on Comparison of the Gerber and Babcock Tests, appended. Adoption was moved, seconded, and unanimously adopted.

Report of the Committee on Quality Program: P. H. Tracy presented reports of subcommittees on the Quality Program. The report of the subcommittee on Cream, appended, was presented by H. C. Olson. The subcommittee on Ice Cream submitted no report. The report of the subcommittee on Cheese, appended, was presented by W. V. Price. The subcommittee on Condensed Milk and Milk Powder submitted no report. The report of the subcommittee on Milk Quality was prepared by H. A. Bendixen (report appended) and discussed by P. H. Tracy.

Tracy moved, that the reports of the Committee on Quality Program be accepted. Motion was seconded and unanimously adopted.

Meeting adjourned June 26, 1942.

PRODUCTION SECTION

Secretary Dwight Espe of the Production Section then gave the following report. On motion duly seconded the report was adopted.

The Production Section held three joint meetings with the Extension Section and one with the Manufacturing Section. On Wednesday, June 24th, papers of special interest, but relating to different fields, were presented on two programs. These programs were presided over by H. A. Herman and K. E. Turk, Chairman and Vice-chairman respectively of the Production Section. The largest total attendance during the day was 130.

The Section held two business meetings, each of which was presided over by Mr. Herman.

Reports from the various standing committees were called for. Copies of these reports are attached. Salient points incorporated in these reports are presented herewith for approval.

1. *Breeds Relation Committee:* The Breeds Relation Committee met with representatives of the various dairy breed organizations. The committee voted: (1) to approve the adoption and use of the Uniform Dairy Score Card; (2) to approve the recommendations of the Purebred Dairy Cattle Association committee on Standardizing Testing Rules and Methods, *with the exceptions* noted on the attached copy. (3) It is further recommended that during the present emergency the minimum requirements with respect to the number of tests required for acceptance and publication of records as contained in the recommendations of the Testing Committee of the Purebred Dairy Cattle Association be approved. (4) That the recommendations of the Committee on Uniform Rules and Methods for Proving Sires and Brood Cows as per attached copy, be accepted.

The report of this committee was approved by the Production Section. The Section voted, with the approval of the Extension Section, to make the Breeds Relation Committee a joint committee from the Production and Extension Sections.

2. *Committee on Measuring Results of Pasture Investigations:* The com-

mittee asked that the American Dairy Science Association go on record as favoring early publication in the Journal of Dairy Science or a suitable journal the report entitled "Pasture Investigations Technique." The report referred to was submitted in December, 1940, by a joint committee from the American Dairy Science Association, the American Society of Animal Production and the American Society of Agronomy. The recommendation was approved by the Production Section.

3. *Committee on Awards for Students National Contest in Judging Dairy Cattle:* Since the recipients of the 1940 scholarships have been unable to accept these awards, due to active service in the war, the committee recommends that these scholarships be held open "for the duration."

4. *Committee on Methods for Proving Sires and Brood Cows:* Report of the committee was read and accepted. The Section voted to appoint a joint committee with the Extension Section to be called the "Committee on Methods for Proving Sires and Brood Cows."

5. *Committee on Silage Methods, Evaluation, etc.:* Report of the committee was read and approved.

6. *Resolutions Committee:* Report of the committee was read and approved.

The question was raised regarding the advisability of electing the officers of the Production Section during the business meeting or by mail. The Section was almost unanimous in voting to continue with the present plan of electing officers at the business meeting.

7. *Nominating Committee:* Report of the committee was read and accepted. G. W. Salisbury (Cornell) was elected secretary and Dwight Espe (Iowa), vice-chairman. K. L. Turk (Maryland), the present vice-chairman, automatically becomes chairman of the Production Section for the ensuing year.

EXTENSION SECTION

Secretary E. C. Scheidenhelm of the Extension Section then read the following report. Upon motion duly seconded it was adopted.

The annual meeting of the Extension Section opened on Tuesday afternoon, June 23 with a joint symposium session with the Production Section on the subject "Nutrition and Reproduction in Dairy Cattle."

The first business session was called to order June 24 at 9:00 A.M. by the Chairman, Glen Vergeront. Thirty members and sixteen guests were in attendance from 16 different states.

During the three day session the program was developed by the various committees within the section. In addition to the Extension dairymen represented on the committees a number of men had been drafted from the Production Section to supplement the program on various topics.

The report of the Testing Committee was presented by the Chairman, R. W. Dickson. Some of the more important recommendations of the com-

mittee in addition to the papers given were: (1) Whenever possible the service of the government employment agencies be used in locating possible men for DHIA work. (2) A cooperative grouping of associations be arranged in the states so that a continuous testing service can be maintained whenever possible. Report was accepted.

E. J. Perry presented the program of the Sire Committee. Two excellent papers were presented pertaining to artificial insemination work. A form is being developed by this group to be used by all artificial insemination work. Report of the committee was accepted.

G. E. Taylor presented the report of the Herd Health Committee. This report emphasized the need of a uniform program between states on health standards. Report accepted.

C. L. Blackman presented the feeding committee report. Report was accepted.

The Quality and Marketing Committee presented an excellent report which was accepted. A motion was passed to solicit the cooperation of the Quality Committee of the Manufacturing Section in holding a joint symposium of the Manufacturing and Extension groups at the next annual meeting of the Association on the subject of Quality Improvement of Dairy Products.

L. O. Gilmore presented the report of the recommendations of the Dairy Farm Management Committee which was to continue developing suitable standard forms for this project. Report accepted.

Reporting of the progress of the 4–H Dairy Club Committee was given by Joe Nageotte. Report of the Committee was accepted.

Progress of the Type Rating Committee was presented by E. C. Scheidenhelm. Report accepted.

The Exhibits Committee reported 11 states presented individual teaching methods and then a joint exhibit was presented by the Dairy Farm Management Committee. Report accepted.

During the business session the final report of the Resolutions Committee was accepted, and presented to General Resolutions Committee.

Two motions were passed to improve the committee work in the Production and Extension Sections. They were: (1) That there shall be a joint committee of the Production and Extension Sections known as the Dairy Cattle Breeding Committee rather than the present title of Sire Committee in both sections. The committee should consist of 6 men, 3 from each section. The chairman of each section to appoint the men representing his section. The chairman of the committee is to be appointed by the joint action of both sectional chairmen. (2) That the Breed Relations Committee be a joint committee of three men from each section, they being appointed by the chairman of their section.

Mr. G. G. Gibson was unanimously elected Secretary of the Section. The

officers for the following year will be J. F. Kendrick, Chairman; E. C. Scheidenhelm, Vice-Chairman; and G. G. Gibson, Secretary.

NECROLOGY COMMITTEE

Mr. Charles Blackman, Chairman of the Necrology Committee, reported the death of the following members during the past year: Lawrence H. Addington, William A. Kyle, R. C. Fisher, Merrill J. Mack, R. S. Fleming. Information regarding the activities of these deceased members was contained in the report of the committee. Upon motion duly seconded the report was accepted to be made a matter of record in the minutes.

REGISTRATION COMMITTEE

Mr. G. M. Trout, Chairman of the Committee on Registration, gave the following report:

Final tabulation showed the total registration at the 37th annual meeting of the Association to be 566 consisting of 394 men, 93 women, and 79 children. Classification of the men showed that 196 or 49.7 per cent were from colleges, experiment stations, and the United States Department of Agriculture, and that 198 or 50.3 per cent were from commercial laboratories, plants, state departments and inspectional staffs. Representatives were present from 38 states, the District of Columbia, and 2 provinces of Canada. The 12 leading states, including the District of Columbia, in representation were:

Michigan	184	Missouri	30	Washington, D. C.	13
Ohio	54	New York	29	Indiana	10
Illinois	51	Pennsylvania	20	Minnesota	9
Wisconsin	49	New Jersey	15	Kentucky	8

Inasmuch as the 37th annual meeting of the American Dairy Science Association was the 16th annual summer meeting of the Association and the second summer meeting held at Michigan State College, it seemed desirable to ascertain the number of meetings that the various members had attended. Consequently, when the letter seeking reservations was sent out a notice was sent also of the meeting places of the Association since 1906. Those anticipating attending the 1942 meeting were asked to check the meetings attended and return this sheet for compilation. Much interest was manifest in the meeting places. Approximately 140 replies from those expecting to attend the 1942 meeting were received.

The attendance at previous meetings of those reporting and who were present in 1942 is presented in Table 1. These data show the relatively high percentage of attendance at previous summer meetings of a cross section of 138 members attending the 1942 meeting and the influence of location of meetings on the attendance of those members. Only one member, E. S. Guthrie, who was present at the first meeting in 1906 was present at the

1942 meeting. Three members, J. H. Frandsen, C. Larsen, and O. E. Reed, attending the second meeting in 1907 were present at the 1942 meeting.

TABLE 1

The number and per cent of 138 members attending the 1942 ADSA meeting who attended previous meetings. Report based on 138 replies to questionnaire and not on total number in attendance at 1942 meeting.

Meeting	Location	Date	No.	Per cent
1st.	Urbana, Ill.	1906	1	0.7
2nd.	Chicago, Ill.	1907	3	2.2
3rd.	Ithaca, N. Y.	1908	4	2.8
4th.	Milwaukee, Wisc.	1909	5	3.6
5th.	Chicago, Ill.	1910	3	2.2
6th.	" "	1911	6	4.3
7th.	" "	1912	6	4.3
8th.	" "	1913	7	5.0
9th.	" "	1914	7	5.0
10th.	San Francisco, Calif.	1915	2	1.4
11th.	Springfield, Mass.	1916	9	6.5
12th.	Columbus, Ohio	1917	8	5.7
13th.	" "	1918	10	7.2
14th.	Chicago, Ill.	1919	19	13.7
15th.	" "	1920	20	14.4
16th.	St. Paul, Minn.	1921	25	18.1
17th.	" " "	1922	25	18.1
18th.	Syracuse, N. Y.	1923	29	21.0
19th.	Milwaukee, Wisc.	1924	24	17.4
20th.	Indianapolis, Ind.	1925	28	20.2
21st.	Detroit, Mich.	1926	34	24.6
22nd.	East Lansing, Mich. (1st summer)	1927	34	24.6
23rd.	Madison, Wis.	1928	36	26.1
24th.	Washington, D. C.	1929	40	29.0
25th.	Ames, Iowa	1930	55	39.8
26th.	Berkeley-Davis, Calif.	1931	9	6.5
27th.	Lexington, Ky.	1932	51	36.9
28th.	Urbana, Ill.	1933	57	41.3
29th.	Ithaca-Geneva, N. Y.	1934	76	55.0
30th.	St. Paul, Minn.	1935	68	49.2
31st.	State College, Pa.	1936	89	64.4
32nd.	Lincoln, Neb.	1937	77	55.8
33rd.	Columbus, Ohio	1938	100	72.4
34th.	Moscow, Idaho,-Pullman, Wash.	1939	45	32.6
35th.	West Lafayette, Ind.	1940	100	72.4
36th.	Burlington, Vt.	1941	97	70.3
37th.	East Lansing, Mich.	1942	138	

The members who have attended ten of *all* the meetings of the Association are: Fordyce Ely of Kentucky, B. E. Horrall of Indiana, Floyd Johnson of Iowa, H. B. Monier of Kentucky, F. B. Morrison of New York, T. S. Sutton of Ohio, and H. E. Herman of Missouri.

Those who have attended eleven of all the meetings are: E. O. Anderson of Connecticut, C. L. Blackman of Ohio, L. H. Burgwald of Ohio, J. C. Hening of New York, H. G. Lindquist of Mass., J. A. Nelson of Montana, Earl N. Shultz of N. H., Paul F. Sharp of New York, H. L. Templeton of Nebraska, L. C. Thomsen of Wisconsin, and G. M. Trout of Michigan.

Those who have attended twelve of the meetings are: R. E. Horwood of Michigan and G. E. Taylor of N. J.

Those who have attended thirteen of the meetings are: H. P. Davis of Nebraska, E. G. Hood of Canada, H. C. Jackson of Wisconsin, C. F. Monroe of Ohio, L. S. Palmer of Minnesota, and K. G. Weckel of Wisconsin.

Those who have attended fourteen of the meetings are: W. E. Krauss of Ohio, H. Macy of Minnesota, E. H. Parfitt of Illinois, W. V. Price of Wisconsin, C. W. Turner of Missouri and R. Whitaker of New York.

Those who have attended sixteen of the meetings are: R. B. Becker of Florida, S. J. Brownell of New York, A. C. Dahlberg of New York, H. O. Henderson of West Virginia, C. F. Huffman of Michigan, and S. M. Salisbury of Ohio.

Those who have attended seventeen of the meetings are: T. W. Gullickson of Minnesota, E. M. Harmon of Illinois, I. W. Rupel of Wisconsin.

Those who have attended eighteen of the meetings are: Earl Weaver of Michigan, and C. A. Hutton of Tennessee.

Those who have attended nineteen of the meetings are: P. S. Lucas of Michigan, A. B. Nystrom of Washington, D. C., and W. E. Petersen of Minnesota.

Those who have attended twenty of the meetings are: A. C. Baltzer of Michigan, A. J. Cramer of Wisconsin, H. W. Gregory of Indiana, E. S. Guthrie of New York, C. Larsen of South Dakota, and W. H. E. Reid of Missouri.

H. W. Cave of Oklahoma attended 21 of the meetings.

A. C. Ragsdale of Missouri attended 24 of the meetings.

Those who attended twenty-five of the meetings are: A. A. Borland of Pennsylvania, J. B. Fitch of Minnesota, and R. B. Stoltz of Ohio.

O. E. Reed of Washington, D. C., attended 30 of the meetings.

J. H. Frandsen of Massachusetts attended 31 of the meetings.

Of the 59 listed as having attended 10 or more of the 37 meetings, J. H. Frandsen heads the list with 31 meetings and O. E. Reed, a close second with 30 meetings. J. H. Frandsen attended 23 of the first 25 meetings while C. Larsen attended 17 of the first 19 meetings.

The names of those attending 10 or more of the 16 summer meetings are given below. Those attending 10 of these meetings are: Fordyce Ely of Kentucky, J. C. Hening of New York, H. A. Herman of Missouri, B. E. Horrall of Indiana, R. E. Horwood of Michigan, C. F. Huffman of Michigan, Floyd Johnston of Iowa, H. B. Monier of Kentucky, C. F. Monroe of Ohio, H. B. Morrison of New York, T. S. Sutton of Ohio, and G. E. Taylor of New Jersey.

Those who have attended eleven of the summer meetings are: C. L. Blackman of Ohio, L. H. Burgwald of Ohio, H. C. Jackson of Wisconsin, H. G. Lindquist of Mass., P. S. Lucas of Michigan, H. Macy of Minnesota,

J. A. Nelson of Montana, L. S. Palmer of Minnesota, E. H. Parfitt of Illinois, Paul F. Sharp of New York, Earl N. Schultz of New Jersey, Hugh L. Templeton of Nebraska, L. C. Thomsen of Wisconsin, G. M. Trout of Michigan, and Earl Weaver of Michigan.

Those who have attended twelve of the summer meetings are: A. C. Baltzer of Michigan, S. J. Brownell of New York, H. W. Cave of Oklahoma, J. B. Fitch of Minnesota, J. H. Frandsen of Massachusetts, H. O. Henderson of West Virginia, A. B. Nystrom of Washington, D. C., W. H. E. Reid of Missouri, S. M. Salisbury of Ohio, and C. W. Turner of Missouri.

Those who have attended thirteen of the summer meetings are: R. B. Becker of Florida, A. J. Cramer of Wisconsin, A. C. Dahlberg of New York, E. S. Guthrie of New York, E. G. Hood of Canada, W. E. Krauss of Ohio, W. E. Petersen of Minnesota, W. V. Price of Wisconsin, A. C. Ragsdale of Missouri, O. E. Reed of Washington, D. C., I. W. Rupel of Wisconsin, and K. G. Weckel of Wisconsin.

Those who have attended fourteen of the summer meetings are: A. A. Borland of Pennsylvania, H. W. Gregory of Indiana, T. W. Gullickson of Minnesota, and R. Whitaker of New York.

R. B. Stoltz of Ohio has attended 15 of the summer meetings.

R. B. Stoltz heads the list of attendance at summer meetings, having attended 15 of the 16. Four others, A. A. Borland, H. W. Gregory, T. W. Gullickson and R. Whitaker have attended 14 of the 16 summer meetings. Honors go to R. B. Stoltz for having attended all of the last fourteen meetings. T. W. Gullickson follows closely with 13, while A. A. Borland, H. W. Gregory, W. E. Petersen, I. W. Rupel, K. G. Weckel and R. Whitaker each have attended 11 years without missing a meeting. A. A. Borland has the enviable record of having attended 25 of the past 27 meetings, missing only two from 1916 to 1942, inclusive.

This report necessarily centers about the 1942 registration. While a record of the number of meetings attended by all the members of the Association would be highly desirable it was next to impossible to make such a compilation. Doubtless the names of many members of long standing not present at the 1942 meeting should have been included in the above lists. Possibly the names of some members present in 1942 have been overlooked. To them apologies are offered. So much interest has been manifest in the meeting places of the Association and the records of attendance that it seemed this compilation was worthy of special effort.

EDITOR'S REPORT

The Editor begs to submit the following brief report to the Board of Directors of the Association:

1. *Summary of Journal Contents.*

A summary of the Journal contents over the past four years is presented in the accompanying table.

SUMMARY OF JOURNAL CONTENTS

	1938–39	1939–40	1940–41	1941–42
Number of original articles	88	94	97	101
Pages of original articles	760	826	892	938
Number of reviews	2	3	5	3
Pages of reviews	26	119	144	80
Miscellaneous	140	98	157	106
Students National Contest, Proceedings Annual Meeting, Announcements, Circulation, Index, Committee Reports.				
Pages of Abstracts	232	206	304	418
Total number of pages printed	1158	1245	1497	1542
Classification of Articles				
Manufacturing articles	52	53	56	59
Pages occupied by Manufacturing	482	450	514	548
Production articles	28	31	35	36
Pages occupied by Production	212	296	316	336
Manufacturing-Production	8	10	6	6
Pages occupied	66	80	62	54
Classification Reviews				
Manufacturing reviews			5	1
Pages occupied by Manufacturing Reviews			144	36
Production reviews				2
Pages occupied by Production Reviews				44

The figures presented in this table represent 11 issues of the Journal for each of the first 3 columns, the June issues not being included. Figures for the present year include 12 issues inasmuch as the present June issue is given over to the publication of original papers. The total size of the Journal has not increased the past year; in fact, it is some 40 pages less than 1940–41.

2. *Abstracts:* You will note a substantial increase in the number of pages of abstracts. During the past year a set of directions for abstractors and associate abstract editors was prepared. These directions were well received and should materially assist in promoting further improvement in our abstract service.

The advance abstract service was started following the sanction of the Board of Directors at the annual meeting of 1940. The principal reason for initiating this program was as follows. At that time we were considerably behind in the publication of manuscripts and it was usually six months or longer from the time a manuscript was received until it appeared in print. Out of courtesy to our contributors the plan was proposed to call attention to their work which would later be published in detail.

We have since managed to catch up on publication until at the present if a reviewer delays in returning an article which has been mailed to him for review the abstract may not appear until the same issue in which the manu-

script appears. Therefore the major reason for undertaking this project is no longer valid. This project might be dropped without any serious curtailment of service to our readers or contributors. I so recommend.

3. *The Twenty-Year Index:* The Twenty-Year Index has appeared. Those who have examined this work are impressed with the magnitude of the undertaking and the masterful way in which the job was done. We wish to publicly express our gratitude and appreciation to Dr. Harold Macy to whom all credit for this lasting contribution is due.

To all of those who have given so generously of their time and energies in our assistance, we wish to express our gratitude. The continued success of our Journal is dependent upon this fine spirit of helpful cooperation.

Upon motion duly seconded the report was accepted.

JOURNAL MANAGEMENT COMMITTEE REPORT

A. A. Borland of the Journal Management Committee then read the following report:

Your Committee on Journal Management beg to respectfully submit the following report covering operations during the year 1941–1942.

Directions for Associate Abstract Editors and Abstractors: The Editor, in collaboration with the associate abstract editors, prepared a set of directions intended to serve as a guide to the abstractors. These directions have for their purpose to set forth a general plan of the work of abstracting, to state the requirements as to content, style, and form, and to improve the quality and uniformity of abstracts. The directions are replete with information that will prove helpful to the abstract editors and the abstractors in their efforts to comply with the editorial policies and standards of the Journal. We congratulate the editor on this worthwhile achievement.

Use of Journal Abstracts in Other Publications: It has come to the attention of our committee that at least in one case an abstractor has been following the practice of supplying the "Journal of Biological Abstracts" with copies of his abstracts made and intended for the Journal of Dairy Science. This was done without the knowledge of the editor or the Board of Directors. We believe such practice to be contrary to the best interests of our Journal and should be discontinued. We, therefore, recommend that your Board establish a rule embodying the sense of the following suggestions:

1. That in as much as abstracts, being paid for by our Association are the property of this Association and not of the paid abstractors, abstractors may not dispose of copies of their abstracts to other publications, and
2. That all requests from other publications upon our abstractors for copies of their abstracts shall be referred to the Editor.

Policy on Distribution of Reprints: There appears to be a tendency on the part of some of the committee chairmen to take charge of the distribution

of reprints of their committee reports. This practice tends to complicate our system of handling reprints, to cause inevitable confusion in our reprint service. It appears desirable, therefore that a definite policy be established on the distribution of reprints of committee reports and of similar special material published in the Journal, preferably in line with the following suggestions:

1. That all orders for reprints of committee reports be referred to the Secretary-Treasurer, and that the distribution of such reprints be handled in a similar way as is now being done with reprints on "Methods of Analysis."
2. That the Secretary-Treasurer invoice the recipients to the extent of fully covering the cost of the reprints.

Price of Journal to Countries Other than the United States and Canada: It has always been the practice of the Journal to charge fifty cents additional for subscriptions from all countries other than the United States, its possessions and Canada. This appears to be an unnecessary hardship, especially to subscribers in North and South America. Upon suggestion by the Secretary-Treasurer, your committee authorized elimination of this extra charge, subject to approval of your Board, making the subscription price of the Journal to all countries in North and South America the same as for the United States and Canada, *i.e.* $6.00 instead of $6.50. We respectfully request the approval of this action by the Board.

Recommendations by the General Board of Dairy Research: We appreciate the suggestions relative to abstract service, review articles, etc., contained in the 1942 Report of the Committee on Abstracts and Reviews of the General Board of Dairy Research, and it is our desire and our effort to cooperate with the General Board of Dairy Research to the best of our ability. In the present abnormal times, however, with a decline of our revenues from membership dues, subscriptions, and advertisements, and with an increase in the cost of issuing the Journal, we have reason to doubt the wisdom of making changes in the Journal set-up that would further increase its operating cost, unless additional revenues can be made available in amounts sufficient to cover the added cost.

Cancellation of Macfarland and Heaton Contract: On account of complete absence of any action on the part of the advertising firm of Macfarland and Heaton in soliciting advertising for the Journal as per their contract that was approved by your Board at last year's Annual Meeting, we recommend cancellation of our contract with the above agency, to take effect at once.

Financial: The financial performance of the Journal for the year 1941 has been satisfactory. Although the income from members and subscribers has been decreasing each year since 1939, and the cost of printing the Journal has gradually increased each year since 1935, the Journal made a net profit

as shown by the annual report of the certified Public Accountant, a copy of which reached every member of the Board of Directors and the Journal Management Committee.

Elimination of Advanced Abstract Service: At the Annual Meeting of 1940, it was agreed that abstracts of papers which were to appear in the Journal should be abstracted for this reason: That it was usually six months or longer from the time an article was received until it appeared in print. By printing the abstract in advance, the readers would know what was to be published. Since we are now pretty well caught up on publications, the advance abstract frequently appears in the same Journal as the original article and the need of printing the abstract separately is not as important as it was when it was longer between receiving the article and the time of its publication. We, therefore, recommend that the printing of abstracts in advance of their publication in the Journals be discontinued in the interest of economy.

It was moved, and seconded, that the Journal Management Committee report be accepted.

SECRETARY-TREASURER'S REPORT

The Secretary-Treasurer gave the following report:

Membership and Circulation: The circulation of the Journal for 1941 excelled all previous years. It reached 2,417. In 1939 it was 2,400 and in 1940 it was 2,374. Last year our 2,417 circulation was made up of 1,292 members, 669 subscribers, 65 associate subscribers and 391 student affiliates.

In 1941 we took in 93 new members, 59 of which paid their $5.00 affiliation fee and 34 were student affiliates and became members without paying a fee. This year up to June 17 we had taken in 69 new members, 34 of which paid the $5.00 fee, and 35 who were former student affiliates.

Assuming that we will have 30 additional new members the balance of this year, we may count on an increase of 100 members each year. How does this compare to our losses? In 1940, 99 of our members were dropped from the rolls because of their being delinquent, 19 resigned their membership, and 5 died making a total loss of 123. In 1942 we have had 5 deaths, 49 resignations, and 130 members are now delinquent. The possibilities are that 30 of these members will still pay their dues, which will make a total loss of 154 members. This is just about 25 greater loss than it was in 1941, and our loss in members this year is estimated at about 50 more than new members we have received, making a net loss of about 50 members.

You may be interested as to which members become delinquent, whether they are new or old. Of the 130 members delinqunt 19 had only been members one year; 21 had been members for two years; 35 had been members for three years; 24 had been members for four years; 10 had been members for five years; and 21 had been members for five years or more.

This brings us to the problem of why men who have been trained in the science of dairying, make their living in this field but who are not sufficiently interested to sacrifice $5.00 per year so that they may continue to receive the Journal of Dairy Science. It is my opinion that during the student's four years in college he has not had impressed upon him the necessity of his continued need of reading to keep up to date.

The Secretary then read a letter from Professor Goss of Iowa regarding the need of assigning articles to be read in the Journal by the students. He commented that we are not making as much use of the Journal and its facilities among our students as the worth of our publication warrants. Professor Goss told in his letter about Weckel of Wisconsin writing to parents of students to have them give a student affiliation as a Christmas letter to their sons.

The Secretary read the number of subscribers from four of the twenty-four foreign countries to demonstrate that those countries who are at war have not decreased their interest in dairy science:

	1938	1939	1940	1941	1942
England, Ireland, and Scotland	55	50	52	46	44
Australia and New Zealand	49	50	50	54	53
Japan	48	45	40	38	.....
U. S. S. R.	34	47	33	36	4

Illinois leads the states in memberships having had 127 members last year. New York leads with suscriptions with 47 last year and 49 this year. Iowa stands first in number of student affiliates both this year and last. They had 56 last year and 48 thus far this year.

Index: 2,000 copies of the 20-Year Index were printed; 1,000 in paper covers and 1,000 in cloth covers. On June 17, 1942, we had delivered 706 paper covered copies, and 363 cloth covered copies.

These indexes cost approximately $4,000. We have received a little more than $1,500 so that the Association will probably be out about $2,000 and the Board of Directors made the price in this way because they believed this was a contribution that they could make to the membership.

All paper bound 20-Year Index are now $2.00, and cloth bound are $2.35; to non-members they will sell for $5.00 and $5.50.

Back Copies: Since the 20-Year Index is now in your hands it would be a good time to complete your back volumes. We suggest that you check your libraries and that they have the complete volumes from one to twenty-four inclusive.

Advertising: Our advertising has been most satisfactory. In 1938 we sold 93¾ pages; in 1939, 124 pages; in 1940, 126½ pages, and last year, 1941, 140¾ pages. The first half of 1942, we have sold 67 pages, which is less than 1941, but a little more than 1940. We are most grateful for those who use our pages as an advertising media. Last year our advertising income

PROFESSOR H. P. DAVIS, PRESIDENT ELECT

amounted to more than $5,000.00 which is equivalent to the dues of 1,000 members. We will appreciate any courtesies shown the advertisers.

Financial: A report of the Certified Public Accountant was sent to each Director the latter part of February. This shows that our income for 1941 was $18,246.59, and our operating expenses were $17,566.03. Our net worth is $20,100.11. We have an investment in Government Bonds of $17,790.00 in addition to the $1,500 worth authorized by the Directors at their Board Meeting yesterday. This does not include income and expenditures of printing the 20-Year Index.

Upon motion duly seconded the Secretary's report was accepted.

The Secretary then read the minutes of the Board of Directors meetings. They will be found following the minutes of this meeting.

A motion was made and seconded that the minutes of the Board of Directors be accepted, and that all action taken by the Board of Directors during the past year be approved and endorsed by the Association. Motion carried.

S. M. Salisbury of the Auditing Committee submitted the following report:

May 16, 1942

To the Members of the American Dairy Science Association

Gentlemen:

Mr. Walter Burnham of Columbus, Ohio, Certified Public Accountant, has made an audit and report of the financial condition of the Association.

The Auditing Committee has conferred with Mr. Burnham and is satisfied that he has made a careful examination of all assets and liabilities of the Association and that all accounts are accurate. The committee is satisfied that the balance sheet and related summary of profit and loss represents the financial condition of the American Dairy Science Association.

Upon motion duly seconded the report was accepted.

Mr. C. G. Bradt of Cornell presented a report of the committee officially appointed by the American Society of Animal Production, the American Veterinary Medical Association, the Poultry Science Association, the U. S. Livestock Sanitary Association, and the American Dairy Science Association to discuss plans for cooperative work on animal disease and productive efficiency. Upon motion duly seconded the report was accepted.

Mr. Paul Sharp of Cornell who had been appointed by President Judkins to represent the American Dairy Science Association on the General Board for Dairy Research reported of their activities.

O. E. Reed, who had been appointed to represent the American Dairy Science Association on the National Research Council gave a report of the work of the Council.

NOMINATING COMMITTEE

Mr. H. C. Jackson of the Nominating Committee gave the following report. Upon motion duly seconded the report was accepted.

For Vice-President: A. C. DAHLBERG and G. M. TROUT
For Directors: R. B. BECKER and DWIGHT SEATH
W. B. NEVENS and W. E. PETERSEN

RESOLUTIONS COMMITTEE

Mr. W. H. E. Reid, Chairman of the Resolutions Committee, submitted the following report:

The American Dairy Science Association assembled in its thirty-seventh annual meeting at Michigan State College, wishes to express for the members, their families and guests, its appreciation for the hospitality, delightful entertainment and splendid facilities provided by the officials and faculty of that college.

Therefore, be it RESOLVED: That the members of the Association publicly express their sincere appreciation to Dean E. L. Anthony; to Professor Earl Weaver and his departmental staff; to the Kalamazoo Vegetable Parchment Company; to the Michigan Dairy Industry Committee; to the Michigan Dairy Herd Improvement Associations; to the National Dairy Products Corporation; to the Borden Dairy Company and to the several departments of Michigan State College and other agencies cooperating in providing the entertainment and many fine courtesies.

WHEREAS: The general health and physical well-being of the men in our armed forces and those of our Allies and our people at home constitute the first essential in our national defense, and,

WHEREAS: We recognize the necessity to safeguard the health and well-being of the American people, that they be encouraged to use more milk, butter, cheese and ice cream and other dairy products consistent with the balance of our Lend Lease aid to our Allies.

Therefore, be it RESOLVED: That this Association urge the Honorable Claude Wickard to issue a statement encouraging the people of the United States to consume larger volumes of milk and milk products and thereby help to adjust existing conditions which now tend to jeopardize the entire dairy industry.

WHEREAS: The United Dairy Committee under the leadership of its capable chairman, Mr. Ralph Ammon, Commissioner, State Department of Agriculture of Wisconsin, has made definite progress in its endeavor to protect the dairy industry of this country,

Therefore, be it RESOLVED: That this Association commend and recognize the efforts of Commissioner Ammon and the members of the United Dairy Committee.

WHEREAS: Our Federal Government has asked for an increase in the total volume of milk as a part of the war program,

Therefore, be it RESOLVED: That we commend the notable efforts that our Dairy Extension Specialists have put forth by aiding the dairy farmers in approaching the national goals.

WHEREAS: The Bureau of Dairying and the Bureau of Home Economics of the U. S. Department of Agriculture, the Federal Food and Drug Administration; the Quartermaster Department of our armed forces; the U. S. Public Health Service; the Departments of Agriculture and the State Departments of Health of our respective states have made worthy contributions to the diet of our men in service, with special reference to milk and milk products,

Therefore, be it RESOLVED: That this Association commend these different federal and state agencies for their respective contributions.

WHEREAS: O. A. Ghigoile, Chief, Bureau of Dairy Service, California State Department of Agriculture; L. G. Kuenning, Chief, Dairy Division, Wisconsin Department of Agriculture; V. L. Fuqua, Dairy Commissioner, Tennessee Department of Agriculture; and Commander Fuchs, Director, Milk Division, U. S. Public Health Service, made able contributions to the program of this annual meeting,

Therefore, be it RESOLVED: That this Association express its sincere appreciation to each of these men.

WHEREAS: The work of a dairy herd improvement association is fundamental in furnishing a background of information for sound and efficient action in 4–H dairy club work, sire proving, dairy cattle breeding, selection and improvement,

Therefore, be it RESOLVED: That this Association hereby commend the work of the Bureau of Dairy Industry U. S. D. A., and the office of Dr. J. F. Kendrick, and that of the several states in this field and bespeak the continuance and the financial support for this work.

WHEREAS: The Purebred Dairy Cattle Association has developed (1) a Standardized Dairy Cow Score Card, (2) Standardized Production Testing Rules, (3) Uniform Rules and Method for Proving Sires and Brood Cows, and (4) Uniform Blanks for the Identification and Reporting of Registered Cows Artificially Inseminated in Cooperative Breeding Association,

Therefore, be it RESOLVED: That the American Dairy Science Association highly commend the Purebred Dairy Cattle Association for this progressive action.

WHEREAS: The demonstrations given at Michigan State College relating to experiments in progress created great interest in these investigations,

Therefore, be it RESOLVED: That other host institutions be encouraged to arrange for similar demonstrations when the nature of the experiments make that possible.

WHEREAS: This Association recognized the importance of awards in giving incentive to students throughout the country for continued activities and study in the field of dairy cattle breeding and production,

Therefore, be it RESOLVED: That donors of prizes for the winners in the National Collegiate Students Dairy Cattle Judging Contest be thanked individually in the name of the Production Section of this Association by the chairman of the Committee on Awards.

WHEREAS: This Association recognizes the importance of awards in giving incentive to students throughout the country for continued activity in study in the field of dairy manufactures,

Therefore, be it RESOLVED: That donors of prizes for the winners in the National Collegiate Students Dairy Products Judging Contest be thanked individually in the name of the Dairy Manufacturing Section of this Association by the chairman of the Committee on Awards.

WHEREAS: The Borden Company is continuing its awards for recommendation of continued research in dairying,

Therefore, be it RESOLVED: That the American Dairy Science Association express its appreciation to the Borden Company for its continued interest in dairying.

WHEREAS: Dr. Harold Macy has made such an excellent contribution to the American Dairy Science Association by preparing the excellent 20-Year Index of the Journal of Dairy Science,

Therefore, be it RESOLVED: That this Association shall express its utmost appreciation to Dr. Macy.

P. F. Sharp moved and G. M. Trout seconded that the report be accepted.

Meeting was then adjourned.

MEETING OF BOARD OF DIRECTORS, AMERICAN DAIRY SCIENCE ASSOCIATION

R. B. STOLTZ, SECRETARY-TREASURER

East Lansing, Michigan, 8:00 P. M., June 22, 1942

A meeting of the Board of Directors of the American Dairy Science Association was held in the library of Abbot Hall Monday, June 22, 1942, at 8:00 P.M.

Present: President H. F. Judkins; Vice-President H. P. Davis; Secretary-Treasurer, R. B. Stoltz; Directors, Fordyce Ely, A. C. Dahlberg, J. C. Knott, G. M. Trout.

The three Sectional Chairmen, J. F. Kendrick, L. H. Burgwald, and H. A. Herman, were invited to meet with the Directors in order to discuss the rules and regulations of the sections.

The Manufacturing and Extension Sections were requested to change the time of incoming officers taking their office from October 1st to July 1st following their election.

The President was authorized to appoint a committee to submit amendments to our Constitution and by-laws. The following were appointed to report at our next annual meeting: A. C. Dahlberg, Chairman; G. M. Trout, and R. B. Stoltz.

Editor T. S. Sutton then presented the report which is printed in the minutes of the General Meeting, followed by the Journal Management Committee report which is also reported in the preceding minutes.

President Judkins then announced that O. F. Hunziker had submitted his resignation from the Journal Management Committee and the Secretary was authorized to notify O. F. Hunziker of the Association's deep appreciation for the many valuable contributions rendered during the many years of his service on the Journal Management Committee.

Davis moved and Dahlberg seconded that O. F. Hunziker be made a life member of the American Dairy Science Association as a token of our appreciation of his work on the Journal Management Committee.

President Judkins appointed A. C. Dahlberg to serve as chairman of the Journal Management Committee.

Ely moved, Davis seconded that the Pennsylvania State Student Branch be given a Certificate of Membership.

The Secretary-Treasurer then gave his report which is printed in the preceding minutes of the General Meeting.

The budget which was mailed previously to all Directors for the year 1943 was approved.

Since each member is given an opportunity to make nominations for the Borden Award at the time of election of officers there seems to be no need of nominating committees for this purpose, and it was therefore moved and seconded that the nominating committee for the Borden Awards be abolished.

The second meeting of the Board of Directors was held in the library of Abbot Hall Wednesday, June 24, 1942, at 11:15 A.M.

Present: President H. F. Judkins; Vice-President H. P. Davis; Secretary-Treasurer, R. B. Stoltz; Directors, H. W. Cave, Fordyce Ely, A. C. Dahlberg, J. C. Knott, and G. M. Trout.

The minutes of the last Board meeting were read and approved.

A letter was read from Director Chas. N. Shepardson stating that it would be impossible for him to attend the Annual Meeting and that it was with sincere regret that they would be unable to entertain our Association in 1943. This condition has been brought about by the accelerated program and the training and housing of fourteen hundred sailors in a naval radio school. He further requested that their invitation be kept on file and that the annual meeting be held in Texas as soon as possible after the termination of the present conflict.

An invitation was read from the University of Missouri to hold our annual meeting in Columbia, Missouri, in 1943.

Cave moved and Davis seconded that the invitation from the University of Missouri for 1943 be accepted.

It was moved by Trout, seconded by Ely that the Secretary-Treasurer be authorized to invest $1,500.00 in (2,000 worth face value) War Bonds Series F.

The board then adjourned.

AMERICAN DAIRY SCIENCE ASSOCIATION PRESENTED BORDEN AWARDS TO H. H. SOMMER AND W. E. PETERSEN

Michigan State College

East Lansing, Michigan, June 25, 1942

Mr. E. L. Anthony acted as toastmaster at the Annual Association Banquet, and presented Mr. W. A. Wentworth of the Borden Company who introduced six of the former recipients of the Borden Award: C. F. Huffman, W. E. Krauss, K. G. Weckel, C. W. Turner, Paul F. Sharp, and L. S. Palmer, who received the Award for the American Chemical Society.

Mr. H. W. Gregory, Acting Chairman of the Committee for the Borden Award in Dairy Manufacturers made the following statement:

"The Borden Awards to the American Dairy Science Association are made possible by the generous support which one of our largest corporations engaged in the Dairy Industry has seen fit to offer each year to two individuals for outstanding research pertaining to dairy production and dairy manufacturing. The Borden Company has insisted that in the administration of these awards, that this Association have complete jurisdiction over the rules covering the method of selection of each recipient, the naming of the recipient, and methods of presentation of the awards.

"Each of the awards consists of a gold medal and one thousand dollars ($1,000.00). The Borden Company has offered these awards since 1936 and the first Borden Award was made in 1937.

"Acting for the Chairman, Dr. N. W. Hepburn of the Dairy Manufacturers Borden Award Committee, it is my privilege and duty to name the recipient of the Dairy Manufacturing Research Award.

"The recipient of this year's award is now engaged in teaching and research in dairy manufacturing in one of our well known mid-western agriculture colleges. He was graduated from this institution in 1918, received his Master's degree in 1919 and his Doctor's degree in 1922 from this same institution. He has made many valuable contributions to dairy science. His contribution to our knowledge of 'Salt Balances in Milk and Dairy Products' and the 'Effect of Metal on Milk Flavors' are outstanding.

"Probably his two greatest contributions are his two dairy text books. His first book was entitled, 'The Theory and Practice of Ice Cream Making' published in 1932 and revised in 1935. In 1938 his book entitled, 'Market Milk and Related Products' was published. These two books are widely used as text books in this country.

"It was the unanimous opinion of the committee that Doctor Hugo Henry Sommer, Professor, Dairy Industry in the University of Wisconsin, be selected for the 1942 Borden Dairy Manufacturers Research Award."

H. H. SOMMER

W. E. PETERSEN

Mr. Sommer came to the platform and Mr. Wentworth of the Borden Company presented him a gold medal and a check for $1,000.00.

Mr. Anthony, the toastmaster, then introduced Mr. O. E. Reed, Acting Chairman of the Borden Award Committee for Production. Mr. Reed then made the following statement:

"Dr. William Earl Petersen was born February 3, 1892, at Pine City, Minnesota. He received his B.S. Degree at the University of Minnesota in 1916, his M.S. degree at that institution in 1917, and his Ph.D. degree at the University of Minnesota in 1928. He was extension dairy specialist at Kansas State College from 1917 to 1920, field secretary for the Minnesota Holstein Breeders Association 1920 to 1921, and has been a member of the dairy husbandry staff at the University of Minnesota from 1921 to the present time where he holds the position of Professor of Dairy Husbandry.

"While Dr. Petersen's chief interest is the physiology of dairy cattle, his researches have extended into the fields of dairy chemistry and dairy cattle breeding and nutrition.

"His most outstanding work has been in the field of the physiology of milk secretion in which his publications include studies relating to the carbohydrate, fat, protein and mineral metabolism of the mammary gland, and also, hormonal, histological, physical and physical-chemical studies relating to milk secretion. The development of the perfusion apparatus, consisting of an artificial heart and lung for the perfusion of excised mammary glands free of the influence of other organs, has been one of his most important recent contributions.

"In addition, his accomplishments include the development of the Minnesota Babcock reagent, widely used in both buttermilk and blood fat determinations and the development of a practical method of evaluating feeds, adopted by Morrison in his latest edition of 'Feeds and Feeding.' His publications also include the widely used book 'Dairy Science' and two secondary school textbooks: 'American Farming and Agriculture,' Volumes I and II.

"Dr. Petersen has continued to grow in his work from year to year and to expand his great capacity for work in varied fields of investigation. He has remained a student and at the present time in addition to carrying on his teaching, researches and other work, attends no fewer than three different physiological seminars each week during the school year. Perhaps his greatest attribute in his unbounded enthusiasm in research work and his ability to instill this enthusiasm in his students with whom he works very closely, frequently remaining in the laboratory until long after midnight.

"The three members of the Production Award Committee have unanimously selected the recipient for the 1942 Borden Award."

Mr. Wentworth of the Borden Company then presented Mr. Petersen the gold medal and a check for $1,000.00.

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ABSTRACTS OF LITERATURE

T. S. SUTTON, Editor
Columbus, Ohio

MILK AND MILK PRODUCTS

Published in cooperation with
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Physiology

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JOURNALS

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American Milk Review
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American Journal of Physiology
American Journal of Public Health
Archives of Pediatrics
Australian Journal of the Council for Scientific and Industrial Research

Biochemical Journal
Biochemische Zeitschrift

Canadian Dairy and Ice Cream Journal
Canadian Public Health Journal
Certified Milk
Cornell Veterinarian

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Dairy World
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Milchwirtschaftliche Zeitung
Milk Dealer
Milk Industry
Milk Plant Monthly
Molkerei Zeitung
National Butter and Cheese Journal
New Zealand Journal of Science and Technology

Oil and Soap

Pacific Dairy Review
Proceedings of Society of Experimental Biology and Medicine

Refrigerating Engineering

Scientific Agriculture
Southern Dairy Products Journal

Tierernährung
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Zeitschrift für Physikalische Chemie, Abt. A and B
Zeitschrift für Untersuchtung der Lebensmittel
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SPECIAL PUBLICATIONS

Federal Dairying and Bacteriological Establishment, Liebefeld, Berne, Switzerland

International Association of Ice Cream Manufacturers
International Association of Milk Dealers

National Institute for Research in Dairying, Reading, England
New York Association of Dairy and Milk Inspectors

Prussian Dairy Research Institute, Kiel, Germany

State Agricultural Colleges and Experiment Stations

The Royal Technical College, Copenhagen, Denmark

United States Department of Agriculture

ABSTRACTS OF LITERATURE

BOOK REVIEW

472. Minerals in Nutrition. Z. T. WIRTSCHAFTER, Reinhold Publishing Corp., 330 W. Forty-Second St., New York. 14 Chapters including summary, plus index, 175 pages; $1.75.

Milk is the source of so many important nutritive factors that having a well rounded knowledge of their properties is often left as a duty of the specialist. As a result, the average worker in the dairy industry knows something about the high-lights of the nutritional properties of milk, but more often little about the properties that frequently are important but overlooked. As an example, the abundance and role of the calcium and phosphorous of milk are known even by the consumer; but how many dairymen know about the occurrence and body need and use of the other minerals in milk, such as sodium chloride or potassium, or sulfur? Minerals in Nutrition is a very interesting popularized discussion on the source, function, disposal in the body, effect of excess or inadequate amounts, metabolism, and organic relationships of the many minerals that have specific functions necessarily derived from our foods. Further, the adequacy of milk in providing the quantities of the various elements is cited. The discussions of Minerals in the Body, Action and Distribution of Minerals, What Salt Does in the Body, Potassium, Calcium, Magnesium, Phosphorous, Sulfur, Iron, Iodine, Other Minerals, Pregnancy, and Lactation are short chapters some 6 to 10 pages each filled with simply presented modern information that will be of interest to sales managers as material for their salesmen, to laboratory and nutrition workers, teachers and students.

The information is presented principally in non-technical readers digest arrangement, and is convenient to read, and easy to comprehend.

K.G.W.

BUTTER

473. A Study of the Quality of Retail Butter in Michigan. I. A. GOULD. Mich. Quarterly Bul. *24*, No. 4: 298. 1942.

The butter studied was obtained directly from retail outlets in the cities of Lansing, East Lansing, Flint and Detroit. The samples were scored for flavor and tested for yeast and mold, mold mycelia, extraneous material, and fat content.

A summary of the results shows that: 1. 45.2% of the samples scored under 89; 2. 75.5% had a yeast and mold count over 20 per ml.; 3. 43.3% had a mold mycelia count over 20; 4. 30.2% had a sediment score of 8 or less; 5. 10.2% contained less than 80% fat.

The results indicated no definite relationship between flavor of butter and price, nor between claims on the package and flavor. It is the author's belief that a butter grading system as a means of protecting the consumer is desirable. P.H.T.

CHEESE

474. A Practical Moisture Test for American Cheddar Cheese. I. A. GOULD, Mich. Quarterly Bul. *24*, No. 4: 318. 1942.

The oil-salt method described is credited with the following advantages over the procedures commonly used: 1. No special apparatus is necessary; 2. Simple to perform; 3. Can be completed in 20–30 minutes.

The recommended procedure of the oil-salt method is as follows: 1. Reduce sample to particles the size of wheat kernels; 2. To an aluminum moisture pan (2–3 inches deep and 2½–3½ inches wide) add 20 ml. oil (olive or cotton seed) for a 5 gram cheese sample and 25 ml. for a 10-gram sample; 3. Add about 1 gram of common salt; 4. Heat oil-salt mixture over flame until fuming occurs and then cool; 5. Balance pan on butter moisture balance; 6. Weigh 5 or 10 gram sample; 7. Tilt pan to make sure all cheese particles are covered with the oil; 8. Heat pan slowly until all bubbling ceases; 9. Cool; 10. Return pan to scales and determine moisture. If a 5-gram sample was used, double the reading. P.H.T.

475. How to Make Cheese Spreads. C. R. BARKER, Chicago, Ill. Natl. Butter and Cheese Jour., *33*, No. 5: 14. May, 1942.

Cheese spreads are combinations of cheese with condensed whey, whey powder, condensed or dry skimmilk or combinations of whey and skimmilk. Spreading qualities are obtained from high moisture or fat. Low-fat "Cream" cheese without rennet is a common base and detailed instructions are given for making it. The acidity of this base is adjusted in the kettle with citric or phosphoric acid or with sodium bicarbonate. Condiments or such cheeses as Limburger, Camembert or Blue cheese are added. Sometimes emulsifying salts and gum stabilizers and buffers are used. Formulas are given for making vinegar-sugar solution; gum paste; Pimento cream spread; Limburger cheese in glass; Special American cheese spread; Relish spread; smoked cheese in sausage casing; and "Nippy"-type cheese. W.V.P.

476. Paying for Quality. ANONYMOUS. Natl. Butter and Cheese Jour., *33*, No. 5: 17. May, 1942.

The Burr Oaks Cheese Factory, Columbus, Wis., grades milk by methylene blue test into two classes, A and B. For B grade milk, 10 cents per hundred is deducted from the regular factory price and prorated among

A grade patrons. If penalties in one month exceed 10 cents per 100 lbs. of A grade then the balance goes to a pool to be paid in December according to average yearly quality tests. Blue tests are made at least once each week and patrons told results immediately. W.V.P.

CHEMISTRY

477. The Isolation of Biotin from Milk. Donald B. Melville, Klaus Hofmann, Eleanor Hague, and Vincent du Vigneaud, Dept. Biochem., Cornell Univ. Med. Col., New York City. Jour. Biol. Chem., *142*, No. 2: 615. 1942.

A method for the isolation of pure crystalline biotin from a milk concentrate furnished by S.M.A. Corporation is described. The yield of biotin was 25 to 40% and the method is suitable for the preparation of relatively large amounts of pure biotin. V.C.S.

478. Does Hydroxyglutamic Acid Occur in Milk Proteins? Ben Nicolet and Leo A. Shinn, Div. Nutr. and Physiol., Bur. Dairy Indus., U. S. Dept. Agr., Washington. Jour. Biol. Chem., *142*, No. 1: 139. 1942.

The work of these authors tends to show that the values given by earlier investigators for the amount of hydroxyglutamic acid in milk are much too high and it is even doubtful if milk contains any hydroxyglutamic acid. V.C.S.

DISEASE

479. The Udder Infusion Treatments in a Herd Program for the Control of Streptococci Mastitis. C. S. Bryan and H. H. Ruhland. Mich. Quarterly Bul. *24*, No. 4: 290. 1942.

The udder infusion treatments for mastitis which principally involve the use of tyrothricin, novoxil, and acriflavin, have been reported to yield recoveries in 80 to 90% of the cases treated. The dairyman, however, should be acquainted with the following facts before he subjects his cows to treatment: 1. It should be determined by laboratory methods whether or not the infection of the udder is due to streptococcic mastitis; 2. Cows in the advanced stages of the disease should be slaughtered; 3. Cows suffering from an acute attack should be treated after the acute stage of the disease has subsided; 4. Due to the effect of the treatment on milk flow it is best to treat cows near the end of their lactation period or while they are dry; 5. The appearance of the milk may be changed as a result of the treatment and should not be used for human consumption during the period it is of abnormal appearance; 6. The treatment does not confer any immunity to the animal even though a cure results. P.H.T.

480. Feeding as a Contributory Factor in the Development of Chronic Mastitis. EARL N. MOORE, H. O. HENDERSON, A. H. VAN LANDINGHAM, AND CHAS. E. WEAKLEY, JR., West Va. Agr. Expt. Sta. Amer. Jour. Vet. Res. *3*, No. 7: 154. April, 1942.

A group of cows was fed a ration of alfalfa hay, silage and pasture with a grain supplement of corn products at the rate of 1 lb. to 3.5 lbs. of milk. The control group received a ration of mixed grains at the same rate. Each grain ration contained approximately 12.5 per cent digestible crude protein. A second group received the same grain ration as the control group above, half receiving 1 lb. to each 3.5 lbs. of milk and the others only a limited amount.

All cows were handled together, but those free of mastitis were milked first. "No appreciable increase in the incidence or severity of mastitis was observed as a result of the kind of ration or the rate of grain feeding under the conditions of these experiments." S.A.F.

481. Concise Methods for the Detection of Streptococci of Lancefield Group B or C in Milk Samples. EDWARD J. FOLEY, Labs. Bact., Univ. Notre Dame, Notre Dame, Ind. Jour. Milk Technol., *5*, No. 2: 94. Mar.–Apr., 1942.

A laboratory method for the detection of bovine mastitis caused by streptococci of Lancefield Group B or C is described. The method employs the Hotis test and Edward's broth which have been modified by the addition of selective inhibitory agents. The procedure used permits the determination of the presence of *S. agalactiae* and *S. dysagalactiae* without the necessity of preliminary plating and pure culture study.

The modified Hotis test used was as follows: 20 ml. (composite) samples of milk are drawn into sterile tubes containing 1 ml. of a solution made up of sodium azide, 1 gram; brom cresol purple, 5 grams; crystal violet, 0.1 gram; distilled water, 1 liter.

The sodium azide inhibits the growth of *Esch. coli,* while the crystal violet is effective in inhibiting the growth of micrococci. The use of these agents permits prolonged incubation of tubes when necessary.

Modified Edward's broth (composition as follows: lactose, 5 grams; crystal violet 1% solution, 1 ml.; sodium azide, 0.1 gram; tryptose phosphate broth (Difco), 1,000 ml.; final pH 6.8–7.0. Sufficient brom thymol blue is added to impart a slight but distinct color to the broth) is inoculated with a loopful of cream from a modified Hotis test after 24–48 hours incubation. (In routine work the author stated that he only inoculates broth with cream from those tubes which are suspicious.) The broth tubes are incubated at 37° C. "Growth of *S. agalactiae* is manifest within 24 hours as soft or granular floccules, discrete in the clear broth. (This appearance is for all practical purposes diagnostic of *S. agalactiae* and further investigation is

usually not required.) *S. dysagalactiae* develops a cloudy growth with more or less sedimentation. With both types the pH falls to 5.0 or below. The volume of work connected with serological identification can be reduced by making films for microscopic examination from broths showing an acid reaction and diffuse turbidity. Only tubes with copious flocculent growth or those shown to contain streptococci by microscopic examination are tested serologically. Those in which growth is not extensive are reincubated and tested the next day if streptococci are demonstrated in the films."

L.H.B.

482. The Role of Disinfectants in the Control of Mastitis. C. S. Bryan, C. W. Darby, W. L. Mallman and A. C. Corbett, Sect. Bact., Mich. Agr. Expt. Sta. Jour. Milk Technol., *5*, No. 2: 77. Mar.–Apr., 1942.

Eleven strains of streptococci isolated from mastitis-infected udders and laboratory strains of *Staphylococcus aureus* and *Echerichia coli* were used to test the germicidal properties of various soaps.

One per cent concentrations of the various soaps in a 5.0% milk suspension were tested at room temperature to determine their killing action in one minute's time. The following soaps were tested: "Lifebuoy," "Neko," "Ivory Soap" and "Flakes," "Super-Suds," "Fels-Naphtha" Soap Chips, "Oxydol," "Rinso," "Lux Flakes," and "Drene" (a sulphonated alcohol). It was concluded that soap solutions and sulphonated alcohols are not satisfactory agents for destroying organisms causing mastitis which may be on the udder. "Hypochlorite solutions containing 1.0 ppm. available chlorine killed alpha, beta and gamma streptococci in less than one minute."

The test showed that 5.0% milk added to a sodium hypochlorite solution containing 200 ppm. of available chlorine reduced the chlorine content to 51.4 ppm. and that this solution did not kill all strains of streptococci in one minute's time.

L.H.B.

483. Mastitis and the Plate Count of Milk. II. The Influence of *Streptococcus Agalactiae* upon the Standard Plate Count of Milk. Max E. Morgan, E. O. Anderson, and W. N. Plastridge, Depts. of Dairy Indus. and Anim. Dis., Univ. Conn., Storrs, Conn. Jour. Milk Technol., *5*, No. 2: 67. Mar.–Apr., 1942.

Samples of mixed milk from 93 herds known to have harbored animals infected with *Str. agalactiae* were plated in triplicate in Edward's medium and in both new and old A.P.H.A. media.

The results showed that 78 of the samples had beta-hemolytic *Str. agalactiae* present. Fifteen of the samples did not show any of these organisms as being present in three 0.1 ml. portions when plated on Edward's medium.

There was no correlation between the total plate counts and the *Str. agalactiae* counts.

It was found that milk from herds showing a greater percentage of infected quarters gave higher *Str. agalactiae* counts. The new standard medium supported an average of 10.3% more colonies than did the old standard medium.

Grade B producers will seldom be penalized for excessive plate counts due to the presence of *Str. agalactiae* mastitis in the herd. Grade A or certified producers are more likely to be affected. According to the standards for the State of Connecticut, if the *Str. agalactiae* counts of each of the 78 samples showing these organisms on Edward's medium were subtracted from the standard agar plate count, it would have changed the grade in only four cases. Three samples would have changed from Grade B to Grade A and one sample from below legal standard to Grade B. L.H.B.

FEEDS AND FEEDING

484. Grass Silage—Feeding Results. C. B. BENDER, N. J. Agr. Expt. Sta., New Brunswick, N. J. Internal. Assoc. Milk Dealers. Assoc. Bul. *34*, No. 14: 309–313. Feb., 1942.

A grass silage fed as a part of the total roughage may replace all the corn silage and part of the hay. A minimum of 6 lbs. of hay seems desirable for milking cows.

Results of 4 years of growth experiments with Guernsey and Holstein heifers gave 8% less than normal gains in silage winter feeding but greater than normal growth on summer pasture feeding. The average for the 4 years was an average Guernsey gain of .91 lb. against Ragsdale's Standard of .9 and an average Holstein gain of 1.17 against a Ragsdale Standard of 1.2. Normal milk production was maintained when feeding 50–70 pounds of good legume or a mixture of legume and grass silage to Holsteins. Hay consumption was limited to 6–10 lbs. per day. Comparing 3 kinds of silage it was found that the ratio of milk to digestible nutrients value was 1.33 : 1 for molasses silage, 1.36 : 1 for phosphoric acid silage and 1.37 : 1 for corn silage. Milk pasteurized and held for 2 days scored 22.3 when alfalfa silage was fed, 20.8 for corn silage and beet pulp 21.0. The milk produced from feeding grass silage showed much greater resistance to the development of oxidized flavor than milk produced on either corn silage or beet pulp. E.F.G.

485. Certain Relationships of Avitaminosis A to Vitamin C in the Young Bovine. P. D. BOYER, P. H. PHILLIPS, W. D. POUNDEN, C. W. JENSEN, I. W. RUPEL AND M. E. NESBIT, Dept. Biochem., Univ. Wis., Madison, Wis. Jour. Nutr., *23*, No. 5: 525. May, 1942.

Eleven calves, 8 Holsteins and 3 Guernseys, were used in this study. The blood plasma vitamin A values of the calves not getting vitamin A sup-

plements decreased to a low level of 0.03–0.05 micrograms per cent after two weeks. Papilledema did not develop until after an average of 5 weeks on experiment and increased intracranial pressure did not occur until an average of 8 weeks after low levels of blood vitamin A were observed.

Pathology due to vitamin A deficiency appeared only after the blood plasma levels of vitamin A have decreased to a low level of 0.05 to 0.07 micrograms per cent or less and remained there for several weeks.

The increased intracranial pressure observed in calves suffering from vitamin A deficiency is paralleled by a marked decrease in the ascorbic acid content of the cerebrospinal fluid. Administration of ascorbic acid to vitamin A-deficient calves resulted in a rise in the ascorbic acid content of the cerebrospinal fluid and a reduction in the cerebrospinal pressure in 3 out of 4 calves.

Reduced urinary excretion of vitamin C in vitamin A deficient rats indicated that the lowered blood and tissue vitamin C is the result of impaired synthesis. C.F.H.

FOOD VALUE OF DAIRY PRODUCTS

486. The Increasing Interest in Fortification of Foods with Vitamins and Minerals. C. A. Elvehjem, Univ. Wis., Madison. Internal. Assoc. Milk Dealers. Assoc. Bul. *34*, No. 11: 249–255. Jan., 1942.

It is suggested that in addition to extending our knowledge with respect to the chemistry of our diet it is necessary that we learn how to apply these newer findings to practical nutrition and that much of the application will continue to be built around milk. A brief review of the history of nutritional discoveries is given with emphasis upon the various vitamins. The rough and tedious methods of biological assay are being supplemented or replaced by chemical methods and more recently by bacteriological methods in the case of nicotinic acid. In spite of cheap vitamin preparations the author believes that the safest program is to rely upon the common foods as a source of vitamins. Since milk is usually used with fruit juices and refined cereal products in the infant dietary the two deficiencies most likely to appear are vitamin B_1 and nicotinic acid. On this account dairymen should be particularly interested in the enriched bread program. Being a good source of riboflavin milk is useful in conjunction with enriched bread which is low in this vitamin. Milk is a good source of B_6 and pantothenic acid. Milled wheat has lost five-sixths of its thiamin and nicotinic acid but only about half of its B_6 and pantothenic acid. It is more important to fortify the average diet with milk than it is to fortify milk. The results of a nutritional program come slowly and we shall see the greatest effects in the next generation. E.F.G.

487. Relation of Volume of Dairy Milk Production to Ascorbic Acid Content of Cow's Milk. A. D. HOLMES AND FRANCIS TRIPP, E. L. Patch Co., Boston, Mass., E. A. WOELFFNER, H. P. Hood and Sons, Boston, Mass., AND G. H. SATTERFIELD, Univ. N. C., Raleigh, N. C. Food Research, *7*, No. 2: 111. Mar.–Apr., 1942.

An investigation of the ascorbic acid (reduced) content of cow's milk was conducted over one year using Guernseys and Holsteins. It was found that the volume of milk produced per day has little influence on the ascorbic acid content but that as the volume decreases the total output of ascorbic acid in the milk drops.

The data indicate that Guernsey milk is slightly higher in ascorbic acid content than Holstein milk. Also that the lowest ascorbic acid level for Guernsey milk was found in milk from animals producing less than five liters of milk per day whereas the highest ascorbic acid level for Holstein milk was from animals producing less than five liters of milk per day. Too few animals were included in the latter groupings, however, to make this comparison conclusive. F.J.D.

488. Riboflavin Content of Some Common Foods. HAZEL E. MUNSELL, Dept. Chem., Columbia Univ., N. Y. Food Research, *7*, No. 2: 85. Mar.–Apr., 1942.

Samples of representative foods from different food groups were assayed, by the rat-growth method, for riboflavin. Data obtained were compared with results obtained by other investigators and summarized in a comprehensive table.

Cheddar cheese exhibited the highest riboflavin content, between 545 to 600 micrograms/100 grams. Dried navy beans were also excellent sources. Milk and lean beef, pork and salmon assayed over 200 μ gm. The results with eggs were variable but averaged well over 200 μ gm. Among the leafy vegetables spinach and broccoli leaves gave high values paralleling their greenness. Green string beans, green peas and endive were on a par with milk. The less-green leaves of cabbage and lettuce gave low value as did also peppers even though green. Roots and tubers gave uniformly low values and cereals were intermediate.

Some factors affecting the precision of the rat-growth assay method are discussed. F.J.D.

ICE CREAM

489. A Comparison of Four Ice Cream Stabilizers. W. H. MARTIN AND W. J. CAULFIELD, Kansas State College, Manhattan, Kansas. I.A.I.C.M. Prod. and Lab. Council Proc., p. 35. 1941.

Optimum amounts to use of the following stabilizers for ice cream were found to be 0.4% Vesterine (a mixture of mono- and di-glycerides and high

test gelatin), 0.35% Kragel, 0.35% of 250 Bloom gelatin, and 0.27% Dariloid. Ether extract, total solids, moisture, color, odor, and pH determinations of the four were made. Gelatin and Vesterine were acid, the other two basic in reaction, as well as characterized by high initial viscosity. Vesterine reduced time required to reach 100% overrun by 18 to 20%. All ice creams made with the various stabilizers withstood two weeks storage equally well. The partial neutralization caused by the basic stabilizers resulted in slightly better body and texture scores, amounting to 0.1 to 0.2 points, although this, while resulting in greater protein stability, had no marked effect on viscosity and exhibited no other advantages. Gelatin and Vesterine stabilized ice creams resisted heat-shock treatment better than the other two. P.S.L.

490. The Influence of Homogenizing Pressures on the Dryness of Ice Cream when Drawn from the Freezer. J. HOFFMAN ERB, Ohio State Univ., Columbus, Ohio. I.A.I.C.M. Prod. and Lab. Council Proc., p. 7. 1941.

Although several factors may operate to produce the desirable dryness sought for in ice cream as it is drawn from the freezer the author confined his study to the effects of homogenization on dryness. Mixes of varying composition were homogenized at varying pressures using single and two stage valves. Mixes homogenized at 1000 pounds were dry in appearance when drawn from the freezer but were partially churned; at 3000 or more pounds pressure they became more wet in appearance; and when rehomogenized the appearance of wetness was greatly increased. This appearance was not in all cases an index of the amount of water frozen in the mix but may be of the thoroughness of fat dispersion. An increase in fat content caused an increase in wet appearance under identical pressures. At 1000 pounds pressures low fat ice creams melted with a curdy appearance and high fat ice creams wheyed off. Smoothness of melting was improved greatly at 3000 or more pounds pressure. Increase in pressure hastened the rate of melting. P.S.L.

491. A Progress Report on a Study of Factors Affecting Shrinkage in Ice Cream. P. H. TRACY, W. A. HOSKISSON AND C. F. WEINRICH. I.A.I.C.M. Prod. and Lab. Council Proc., p. 16. 1941.

Several factors are listed which encourage or discourage shrinkage in a normal 12% fat mix, homogenized in double and single stage homogenizers at usual pressures. Except in one series, paper Sealright containers were used. After hardening, the samples were subjected for 30 minutes to an hour to 25 inches of vacuum and then returned to the low temperature room. An increase in fat, serum solids or sugar increased shrinkage. Shrinkage increased usually in the following order from least to greatest with these sugars: "Frodex," "Sweetose," sucrose, and dextrose; and for these stabi-

lizers: gelatin, sodium alginate, "Hygell," and pectin. Dry egg yolk, monoglyceride, sodium caseinate, high overrun, high sugar content, protein destabilization, smaller ice crystals, smaller air cells, continuous freezing, chocolate liquor, and use of unparaffined paper containers favor shrinkage. Factors found to discourage shrinkage were high drawing temperatures, superheated condensed milk, precipitated protein in condensed milk, exposure to melting temperatures, and manufacture of strawberry and chocolate ice creams, the latter made from cocoa. In the discussion considerable attention is given in the article to ice structure and strength of air cells. P.S.L.

492. Lecithin, Lecitho-Protein, and Glyceryl Monostearate in Ice Cream. K. V. BRYAN, Purdue Univ., Lafayette, Ind. I.A.I.C.M. Prod. and Lab. Council Proc., p. 29. 1941.

The action of lecithin and glyceryl monostearate has been ascribed theoretically to their properties as wetting agents. A normal 12% fat mix was divided into three portions before pasteurization, to one of which was added portions of commercial lecithin varying from 0.15 to 0.50%; to a second, lecitho-protein varying from 0.03 to 0.15%; and to a third, glyceryl monostearate varying from 0.18 to 0.30%. The first two improved body and texture of the ice cream but retarded overrun-incorporation somewhat. The third improved whipping ability but slightly weakened the body. A mixture of the second and third produced a satisfactory ice cream. P.S.L.

493. Sugar Is More Than a Sweetening Agent. ALAN LEIGHTON, Div. Dairy Res. Labs, U. S. Bur. of Dairy Indus. Ice Cream Trade Jour. *38*, No. 5: 14. May, 1942.

In addition to their sweetening value, sugars also expand to a marked degree the temperature range within which the product remains in a palatable semi-frozen condition. Also sugar is sufficiently soluble to remain in solution in the unfrozen water of frozen desserts, except occasionally in water ices. It adds bulk to the unfrozen phase of which volume and viscosity are important for the quality of the product. This highly viscous unfrozen phase holds the air cells, and dilutes and lubricates the ice crystals and the milk solids particles, giving the characteristic smoothness essential to frozen desserts.

To prevent sugar crystallization in sherbets held at low storage temperatures, a certain per cent of dextrose is substituted for part of the sucrose.

Data indicates that dextrose is about 62.5 as sweet as sucrose depending on the concentration of sucrose, while in an ice cream mix it has a sweetening value of 89 compared to sucrose as 100.

Other sugars and syrups may be used to replace part of the sucrose in frozen desserts and invert sugar has also been recommended. In substituting for sucrose it may be necessary to increase the total solid content of

the mix and lower freezing and storage temperatures if the ice cream is to remain in a satisfactory condition. W.H.M.

494. Working Directions for Ice Cream Sweeteners. P. S. Lucas, Mich. State Col. Ice Cream Field *40*, No. 3: 22. 1942.

The author gives a number of ice cream formulas in which sucrose substitutes were used during the last world war, and lists several compilations giving relative sweetness of various sugars and sweetening agents. Considerable variation exists in the relative sweetness of the same sugars as reported by different authors.

Honey is suggested to replace 20% sucrose and using this mix for all flavors without complaint. Amber and light colored honey are recommended as being better than dark colored and strong flavored honey such as buckwheat, sage, and basswood.

In ordinary usage corn sugar has been employed to replace 25% of sucrose but it can be safely used to replace 33%.

Corn syrup, composed of glucose, dextrines and maltose, affects both taste and body. When used in excess of 25%* in the replacement of sucrose it imparts an unpleasant taste. This also increases the smoothness and "chewiness" of the ice cream. Glucose,* a heavy syrup, is little more than ⅓ as sweet as sucrose and should not be used in excess of 25% of the sucrose according to the author. Invert sugar can also be used to the extent of 25%. Dried corn syrup solids likewise can be used to replace 25% sucrose. Because of cost or low sweetening value few other sweeteners are available to the ice cream manufacturer.

* Abstract editor comment. Many plants are using 25 to 50% replacement with corn syrup without complaints from the trade. W.C.C.

495. Sugar Problems. Evan R. Bowins, New State Ice Cream Co., Oklahoma City, Okla. Ice Cream Field *40*, No. 3: 34. 1942.

Sugar is not only a sweetener but it affects (1) body and texture of the ice cream, (2) melting resistance of the finished ice cream, (3) freezing point of mix, (4) time required to freeze, and (5) time required to obtain desired overrun. Besides it has often been used as a cheap source of solids even though the sweetening value was not needed. Since 1924 the sugar content in ice cream has been gradually increased until now we are using 35 to 45 pounds more per 100 gallons of mix.

Mention is made of the use of corn and invert sugars in conjunction with sucrose in ice cream. Figures are given to show that using the method of hydrolysis proposed by Ruehe and assuming invert sugar to be 40% sweeter than sucrose, that a combination of sucrose and invert sugar can be used to give 12% sugar in the mix with a sweetening equivalent of 13.6% compared to sucrose alone. Sugar restrictions in other fields will influence consumer tastes for sweetness in ice cream. W.C.C.

MILK

496. The New Orleans Market for Fluid Milk. R. M. GRIGSBY AND R. A. BALLANGER. Louisiana Bul. No. 339. Feb., 1942.

Within the city limits of New Orleans there are 113 small dairies where milk is produced and sold directly to the consumers. Of these, 107 average less than 2 acres each in total land area and have an average of 30 milk cows. Abandoned graveyards, vacant lots, canal and river banks are the principal sources of pasteurage. The most widely used dairy feed is brewery mash. The milk is produced under conditions that resemble a manufacturing process more than normal dairy farming. That part of the supply area further from the city resembles more the normal type of dairy farming. Approximately 265 producer-distributors deliver their milk daily to consumers in the city. This represents 36% of the fluid milk consumed in the market. Most of the producer-distributors handle only unpasteurized milk. Of the total handled by this group, 15% is pasteurized.

Much (86.5%) of the milk in New Orleans is sold wholesale indicating that consumers purchase most of their milk through stores. This is thought to be due to (1) the relatively low per capita income, (2) the high temperatures which prevail throughout most of the year, (3) the lack of refrigeration in many of the homes, and (4) a 2 to 3 cent spread in the price of home delivered and store milk.

Each individual handler (aside from the producer-distributors) pays for his milk according to its use. Consequently there is a variation in the price the farmers receive. There has been an increase in the total amount of milk entering the New Orleans market in recent years. A high class 1 price which encouraged production resulted in little change in the average price received by the farmer due to the increased amounts of milk in class 2 and 3. A high class 1 price has caused some dealers to raise the retail price of milk which resulted in a decreased demand and consequently a greater amount of milk in class 2 and 3. It is questionable whether New Orleans' dairymen can profitably produce milk to be manufactured into butter, cheese and condensed milk. P.H.T.

497. Development of Oxidized Flavor and Speed of Oxidation of Ascorbic Acid in Milk. G. H. HARTMAN AND O. F. GARRETT, N. J. Agr. Expt. Sta., New Brunwick, N. J. Jour. Milk Technol., *5*, No. 2: 86. Mar.–Apr., 1942.

In samples of mixed herd milk pasteurized in the College Creamery, it was found that milk was being contaminated with copper from a bronze pump, and the milk developed an intense oxidized flavor by the end of 72 hours. Replacing the pump with a stainless steel one reduced the development of the flavor decidedly but did not prevent it entirely. It was noted

that the rate of oxidation of ascorbic acid was coincident with the development of the oxidized flavor. L.H.B.

498. Freezing Cream for Storage. G. M. TROUT, Mich. Agr. Expt. Sta., East Lansing, Mich. Milk Dealer, *31*, No. 7: 38–40. April, 1942.

A discussion of the uses for frozen cream and the problems involved in the freezing of cream for storage purposes are presented. A report is then given of the studies made at the Mich. Agr. Expt. Sta. The results of these experiments are as follows: 1. Cream to be stored frozen must be pasteurized at least at an exposure of not less than 165° F. for 15 minutes and preferably 185° for 5 minutes. The high temperature exposure seemed to have a marked effect upon stabilization of flavor, thus inhibiting the development of oxidized flavor. 2. Homogenization had very slight inhibitory action towards oxidation. 3. High carotene content of cream did not stabilize the cream against metal-induced oxidized flavor. 4. Frozen cream of high initial titratable acidity was prone to develop off-flavors upon storage, particularly when pasteurized at 150° F. for 30 minutes. 5. High quality, low-acid cream, free from copper contamination, may be safely stored over an extended period. 6. The type of container in which cream may be stored was of little consequence so far as off-flavor development was concerned. 7. The "oiling off" of frozen cream is affected by rate of freezing, rate of defrosting, fat content, addition of sugar, and homogenization. 8. Only high-fat, excellent quality, low-acid cream, free from copper contamination, should be considered for freezing. C.J.B.

499. Standardization of the Titratable Acidity Test. J. G. DAVIS AND G. M. SODEK, Natl. Inst. for Res. in Dairying, Shinfield, Reading. Milk Indus., *24*, No. 10: 33–35. 1942.

The titratable acidity test is the favorite test in the dairy industry for the detection of souring or incipient souring. In England much of the milk required for liquid consumption has to travel long distances and does not reach the consumer for thirty-six hours or longer. As a result more sensitive and accurate tests are required for assessing the quality of the individual producer's milk.

The titratable acidity test is not an accurate measure of the degree of souring of milk because fresh milk contains relatively no lactic acid and when milk is titrated the very weak acidity of the protein changes to a mild alkalinity. Phenolphthalein indicator does not give a sharp end point in the titratable acidity test.

Since the titratable acidity test is only an arbitrary measurement and has no constant relationship to the lactic acid present, realization must be made, if the test is to be used for a standard of quality in milk, that all details of the test must be standardized. The amount of indicator, method

of reading the burette, determining the end point, measuring the volume of milk, carbonation of the soda, and temperature are factors which affect the laboratory results.

The authors recommend the following procedure: Titrate twenty ml. or 20.64 grams of milk with $\frac{N}{10}$ alkali, using 2 ml. of 0.5% phenolphthalein as an indicator. Titrate to a grayish pink color which compares with a control sample held in a similar dish or flask. The determination should be made at a temperature between 55 and 75° F. J.J.S.

500. Recent Canadian Research on the Resazurin Test. C. K. JOHNS, Dominion Dept. of Agr., Ottawa, Canada. The Internatl. Assoc. of Milk Dealers. Assoc. Bul. *34*, No. 11: 256–265. Jan., 1942.

A "triple reading" test was found superior to the "one hour" test in detection of high bacteria and leucocyte counts. This "triple reading" test consisted of using a single color standard (their No. 8 P7/4 Munsell notation) approximately half way between the original blue and the pink. All samples showing a greater color change than this in one hour were placed in 4th grade, those showing a similar change between the 1st and 2nd hours in 3rd grade; those doing the same by the 3rd hour would be in 2nd grade; while the remainder would be 1st grade. This method of reading reflected high leucocyte counts much more definitely than did either resazurin "pink" or methylene blue reduction tests. The dye seems to be sensitive to certain compounds in abnormal milks which do not influence the electrode potential. Sediment was removed from high leucocyte milk by centrifugal force and then added to low leucocyte milk. This was repeated four times. This sediment still hastened the color change which showed that the leucocytes themselves might be a causative agent. The color change is independent of potential and oxygen content. It is suggested that the resazurin test be widely tried out in the industry even though the dye itself may not yet be entirely standardized. E.F.G.

501. An Economic Analysis of Fluid Milk Markets in Indiana. C. M. HARDIN, Purdue Univ., Lafayette, Ind. Bul. *463*. 1941.

In 1940 control board price fixing orders were operating in 22 Indiana fluid milk markets. Three of these were operating under both federal and state orders.

In the period 1937 to 1940 lowest blend prices for milk were paid in the larger markets. At the same time milk receipts in these markets showed no evidence of decreasing.

Larger markets tended to have greater seasonal fluctuation in receipts due to the larger proportion of smaller producers whose seasonal production fluctuates more than that of the larger producers.

The dealers in the small markets attempt to keep the surplus down to a minimum while in the larger markets where a greater volume is handled making efficient manufacturing possible, there is less incentive for keeping surplus milk at a minimum.

In the Indianapolis market if the total receipts had been reduced until 80% instead of 51% of the total receipts were used for class 1 purposes, the retail price of milk could have been reduced ½ cent during the 4-year period 1937–1940, without affecting the blend price to producers.

The retail price of milk and dealer's margins were higher in the larger cities.

The blend prices for 4% milk equivalent in the 20 fluid milk markets averaged 35 cents per hundredweight higher than prices paid by condenseries during the 4-year period 1937–1940.

While the amount of milk received during the 1937–1940 period increased, the number of producers decreased.

In 1940 in the 8 markets which operated on the base and surplus plan during the 4 years, daily receipts during the month of highest production were 120% of daily receipts during the month of lowest production. In those markets not operating on the base and surplus plan the receipts during the high month were 149% of receipts during the low month.

A correlation existed between the monthly index of business activity in Indiana and the consumption of fluid milk during the period 1937 to 1940.

P.H.T.

502. The Supply and Utilization of Milk in Indiana. C. M. HARDIN, Purdue Univ., Lafayette, Ind. Bul. *462*. 1941.

Of the 3 billion pounds of whole milk equivalent (4% fat) delivered to Indiana plants in 1939, 57% was in the form of whole milk, 42% in the form of cream, and 1% in the form of farm-made butter. The quantity of cream delivered between 1919 and 1939 changed very little while milk increased from 26% in 1919 to 57% in 1939 of the total receipts.

The utilization of the milk and cream received in 1939 was approximately as follows: Butter 50%; Fluid 22%; Cheese 8%; Condensed 8%; Ice Cream 3.6%; Sweet cream for eastern markets 4.0%; Fluid milk for Chicago 4.0%.

Cheese plants in Indiana average about four times as large as those in Wisconsin. This was thought to be due to the fact that the Indiana plants draw milk from a larger area and most of them have been built since 1926 by large corporations. One-fourth of the cheese plants made half of the total cheese produced in 1939.

The 13 organizations of regional or national scope that operated in Indiana during 1939 handled about half of the combined milk and cream receipts for the state. Five of these organizations handled a third of the total receipts.

The seasonal fluctuation in the receipts of cream from farms is greater than that of milk.

The per capita consumption of fluid milk and cream in Indiana for the year 1939 averaged .60 pint per day. P.H.T.

PHYSIOLOGY

503. Lactogenic Content of Pituitaries of Pseudopregnant Rabbits. JOSEPH MEITES AND C. W. TURNER, Univ. Mo. Proc. Soc. Expt. Biol. and Med., *49*, No. 2: 193. Feb., 1942.

Pseudopregnancy was induced in 11 New Zealand White rabbits by the intravenous injection of 100 I.U. of chorionic gonadotropin. Seven normal, mature, female rabbits served as controls. Twenty days later all animals were killed and their pituitaries were removed for assay. The pituitaries from the control rabbits contained an average of 10.05 Reece-Turner lactogen units per gland and the pituitaries from the pseudopregnant rabbits contained an average of 10.25 R.-T. units per pituitary. It was concluded that the reason no substantial lactation occurs in the rabbit during pseudopregnancy is because the amount of lactogenic hormone in the pituitary is too low. R.P.R.

504. Extraction and Assay of Lactogenic Hormone in Postpartum Urine. JOSEPH MEITES AND C. W. TURNER, Univ. Mo. Jour. Clin. Endocrinol., *1*, No. 11: 918. Nov., 1941.

Two methods were described for preparing postpartum urine for the assay of lactogenic hormone. The first consisted of an alcoholic precipitation and in the second the fresh urine was dialyzed and then concentrated by evaporation. The micro pigeon test was used for the assay of urinary lactogen. The urine of 10 lactating women during the first 2 postpartum weeks revealed a daily range in hormone excretion of from 4.05 to 12.50 international units of lactogen. In 3 cases of definite or suspected hypogalactia less lactogenic hormone was found in the urine than in mothers with adequate lactation. The 3 best lactating women excreted the highest average amount of lactogen in the urine. Pregnancy urine contained only $\frac{1}{8}$ to $\frac{1}{16}$ the amount of lactogen found in postpartum urine. R.P.R.

505. A Comparison of the Acetone Body Metabolism of the Lactating Mammary Gland of the Normal Cow with that of the Cow with Ketosis. J. C. SHAW, Dept. Dairy Indus., Storrs Agr. Expt. Sta., Storrs, Conn. Jour. Biol. Chem., *142*, No. 1: 53. 1942.

The lactating mammary gland of the cow in ketosis used over 100% more B-hydroxybutyric acid per 100 cc. of blood traversing the gland than the gland of the normal cow. Simultaneously there appears to be a decrease in oxygen utilization.

Practically all of the oxygen taken up by the lactating gland of the cow with ketosis would be needed for the complete combustion of the B-hydroxybutyric acid removed from the blood by the gland.

In the normal gland only 37% of the oxygen consumed would be required for the complete combustion of the B-hydroxybutyric acid used. It is suggested that much of the energy for milk production in the normal gland is derived from the oxidation of fat in which approximately 37% of the oxygen consumed is used in the oxidation of B-hydroxybutyric acid, while the remaining 63% is used in the oxidation of other fat.

Acetoacetic acid is not utilized by the active mammary gland of either the normal cow or the cow with ketosis. V.C.S.

506. Growth and Development with Special Reference to Domestic Animals. LIII. Resting Energy Metabolism and Ventilation Rate in Relation to Body Weight in Growing Jersey Cattle, with a Comparison to Basal Energy Metabolism in Growing Man. SAMUEL BRODY, H. H. KIBLER, AND A. C. RAGSDALE, Univ. Mo., Columbia, Mo. Mo. Agr. Expt. Sta., Res. Bul. 335. Dec., 1941.

"This bulletin presents charts, prediction tables in various units, and the fitted equation $Y = aX^b$ relating resting-maintenance energy cost, Y, to body weight, X, for the same 18 Jersey cattle from birth to 25 months of age. These results are compared to a similar analysis of energy metabolism (mostly "basal metabolism") in humans from birth on. The value of the exponent b in the above equation is near unity from birth to 5 months in cattle and birth to 3 years in children; and near 0.6, from 6 to 25 months in cattle and 3 to 16 years in children. The metabolism per unit surface area rises from birth to about 6 months in cattle and from birth to about 3 years in humans; it remains roughly constant 6 to 25 months in cattle and declines somewhat 3 to 16 years in humans. Similar data are presented for the relation of ventilation rate to body weight in cattle. The value of b in the above equation for ventilation rate in cattle is about 0.72, from birth to 25 months. Oxygen decrement in the ventilated air declines with increasing body weight; that is, more oxygen is taken out from a given volume of inspired air in the smaller animals. The implications, practical and theoretical, to students of nutrition and of ventilation and air-conditioning engineering, are discussed." Authors' Abstract

507. Growth and Development with Special Reference to Domestic Animals. LII. Relation Between Organ Weight and Body Weight in Growing and Mature Animals. S. BRODY AND H. H. KIBLER, Univ. Mo., Columbia, Mo. Mo. Agr. Expt. Sta., Res. Bul. 328. May, 1941.

"Detailed charts are presented relating the weights of each of the major

visceral organs to the corresponding body weights in 1) mature mammals of different species; 2) mature birds of different species; 3) animals of the same species, growing and mature. The relative-growth equation $Y = aX^b$ was fitted to each set of data, and the numerical values of the exponent, b discussed with reference to the metabolic levels. For mature animals of different species, the weights of the neuro-endocrine system, such as the brain and pituitary gland, which are the metabolism-controlling organs, tend to increase with approximately the same fractional power as does *basal* metabolism; the cardio-respiratory systems, such as the heart, which carries the working burden of the body, tends to increase more directly with body weight than with the *basal* metabolism. The organ-body relations in growing animals vary with the stage of growth; the value of b tends to be lower for later growth in the same species than for mature animals of different species. The results are discussed from theoretical and practical view points." Authors' Abstract

MISCELLANEOUS

508. Man Power and Transport Economics. S. CLIFFORD. Milk Indus., *24*, No. 10: 25. 1942.

Proposals are suggested to prohibit milk customers in England from changing their retailer and to prohibit the misuse of milk bottles by Order during the war. A proposal was made for the standardization of milk churns but that the use of churns with long shoulders be continued as they went a long way to avoid spillage. J.J.S.

509. Public Health Compliance by Manufacturers of Paper for Packaging Perishable Foods. J. R. SANBORN, N. Y. State Agr. Expt. Sta., Geneva, N. Y. Jour. Milk Technol., *5*, No. 2: 88. Mar.–Apr., 1942.

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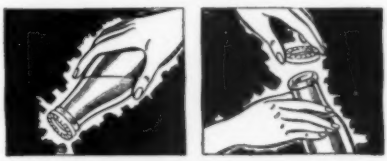

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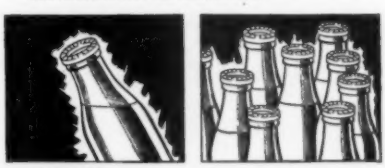

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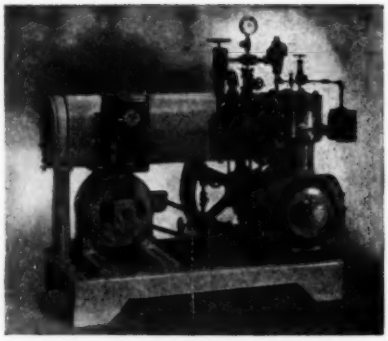
PHILADELPHIA

Your advertisement is being read in every State and in 25 Foreign Countries

WHATEVER YOU NEED IN REFRIGERATION



CP has been building economical, dependable refrigeration for more than 45 years. The complete CP line . . . whch embodies many distinctive design and construction features of basic value in the processing of dairy products . . . includes Vertical Ammonia Compressors in capacities from 10 to 105 tons, and Self-Contained Ammonia Refrigerating Systems in capacities from 1½ to 8½ tons. Whatever the type required, the owner of CP Refrigeration equipment is assured of silent, smooth action, low power cost and extra years of service with extremely low maintenance cost.

Because Creamery Package has been a leader in the development of both refrigeration and processing equipment for the dairy industry, CP engineers are particularly well qualified to recommend the exact type and size of refrigeration system to work most efficiently with every combination of processing equipment.

Has It

THE CREAMERY PACKAGE MFG. COMPANY
1243 West Washington Boulevard, Chicago, Illinois
Creamery Package Mfg. Co. of Canada, Ltd.
267 King St., West, Toronto, Ont., Canada
The Creamery Package Mfg. Company, Ltd.
Avery House, Clerkenwell Green, London, E. C. 1, England

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DIFCO

Bacto-Tryptone Glucose Extract Agar
for Plate Counts of Milk

"Standard Methods for the Examination of Dairy Products" of the American Public Health Association specifies the use of tryptone glucose extract milk agar for determination of the plate count of bacteria in milk. This medium replaces the nutrient agar previously employed for this purpose.

Bacto-Tryptone Glucose Extract Agar is prepared from approved and standardized ingredients in accordance with the specifications of the official formula. When it is made up for use it corresponds exactly with the standard medium except that it does not contain skim milk. When dilutions of milk greater than 1 to 10 are to be plated one per cent skim milk should be added to the medium.

Bacto-Tryptone Glucose Extract Agar requires no filtration and has a reaction of pH 7.0 after autoclave sterilization. Colonies developing on plates of this medium are large and are representative of the bacterial flora of milk.

Bacto-Skim Milk is recommended for use with Bacto-Tryptone Glucose Extract Agar when dilutions of milk greater than 1 to 10 are plated.

Specify "DIFCO"

THE TRADE NAME OF THE PIONEERS
In the Research and Development of Bacto-Peptone and Dehydrated Culture Media

DIFCO LABORATORIES
INCORPORATED
DETROIT, MICHIGAN

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